AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

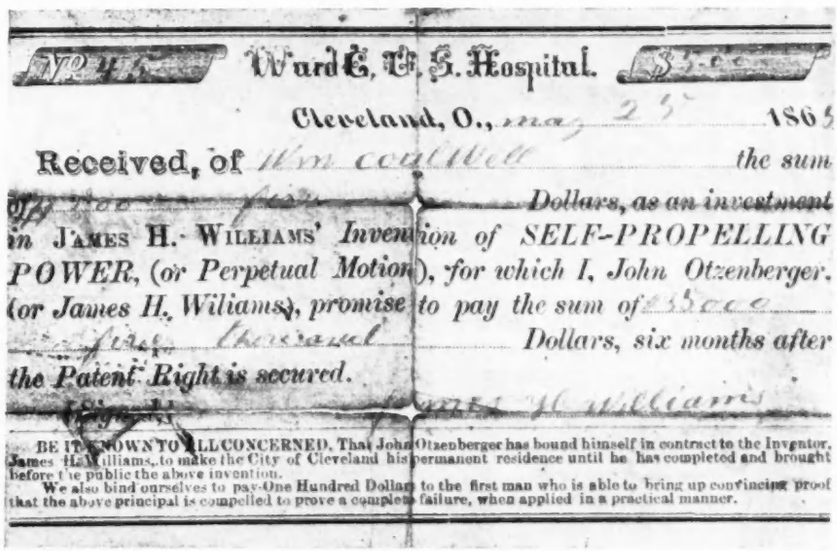
▲ ▲ ▲

VOLUME 21. NEW YORK, THURSDAY, JUNE 23, 1898. NUMBER 25.

▲ ▲ ▲

Perpetual Motion Financiering.

The receipt, certificate of stock or whatever it may be called, which is shown herewith is something of a curiosity. It tells in itself all the history which attaches to it, except that the document was found among the papers of a man who recently died, and represents a part of the assets of the deceased. Whether he left anything more valuable we are not informed. The paper gives not the slightest hint as to the "principle" involved in the invention to which it relates, but that is not of any consequence. There is one peculiarity about perpetual motion devices that has never, as far as we know, been realized anywhere else, and that is that one is precisely as good and as valuable as another. You can't say that of anything else that we know of, not even of a rotary engine. We do verily believe that some rotary engines are better than others, and that some are not as good, but we are not prepared to substantiate any such statement in the perpetual motion field. It is encouraging to have the opportunity to note also the advance which has occurred in perpetual motion values. This document guarantees, as well as it can, the payment of a thousand to one upon the investment, but the date of it is more than thirty years ago. We could almost undertake to produce at this later day, from the circle of our mechanical acquaintance, a man who would promise at least five thousand to one when his perpetual motion motes. The certificate, having been issued from a ward of a United States hospital, and just at the close of the civil war, shows that the inventor was a veteran whom the ravages of conflict had spared so that his invention might not be lost to the world. The promise to pay six months after the patent is secured is a reminder of the Confederate notes which were to be paid a certain time after the ratification of a treaty of peace. Otzenberger seems to have been the financier and Williams the inventor, and the binding of the financier not to run away was an unusually brilliant idea for an inventor. As there is no record that the "first man" ever claimed his hundred dollars, as offered in the last sentence, the value of the certificate is apparently unimpaired.



Ward G, U. S. Hospital.

Cleveland, O., may 25 1865

Received, of Wm Cottrell the sum

Dollars, as an investment

in JAMES H. WILLIAMS' Invention of SELF-PROPELLING POWER, (or Perpetual Motion), for which I, John Otzenberger, (or James H. Wiliams), promise to pay the sum of Three

five thousand Dollars, six months after the Patent Right is secured.

James H Williams

BE IT KNOWN TO ALL CONCERNED, That John Otzenberger has bound himself in contract to the Inventor, James H. Williams, to make the City of Cleveland his permanent residence until he has completed and brought before the public the above invention.

We also bind ourselves to pay One Hundred Dollars to the first man who is able to bring up convincing proof that the above principal is compelled to prove a complete failure, when applied in a practical manner.

PERPETUAL MOTION STOCK.

▲ ▲ ▲

"The United States is rapidly becoming the greatest industrial country in the world and our most formidable rival in the markets which have hitherto afforded an outlet for our manufactured products."—Engineering.

A Fatal Scrap Iron Explosion.

BY W. H. WAKEMAN.

We have been repeatedly warned of the danger attending the practice of breaking up cast iron pistons and other larger pieces of similar material, but the following account shows that the cutting up of wrought iron is not free from danger.

Patrick Lawlor was in the employ of the New Haven Rolling Mill Company, located at New Haven, Conn., for twenty years, and it was his business to cut up the scrap iron and prepare it for the furnaces. On Friday morning, June 10, he went to work as usual, and at five minutes before 8 o'clock took up an iron cylinder about 6 inches in diameter and 3 feet long, put it in the proper position for the heavy shears to cut it in two about the middle, and awaited the descent of the powerful blade, but when the cylinder had been flattened and partially cut there was a loud report, followed immediately by the sound of rending timbers. A laborer was thrown down by the concussion, but not seriously injured. An employé of the company, who was in the yard, saw a portion of the cylinder come up through the roof, followed by the arm of the unfortunate man, and they ascended about 40 feet in the air, the arm falling on the roof and the cylinder landing on the ground about 75 feet from its starting point. It severed a 2x6-inch rafter during its ascent in addition to the stout roof boards. The roof is 20 feet above the mill floor. Lawlor was found a short distance from the shears, lying face downward. The whole top of his head was blown away, and his death must have been instantaneous.

The iron composing the cylinder was nearly one-quarter inch thick, and one-half of it was flattened out as if it had been unrolled like a piece of cardboard, while the other was nearly as flat, both of them having been rent longitudinally by the force of the explosion.

The bottom of the cylinder is concave and appears to have been welded in place, as no riveted seam is found in any part of the construction. The head is flat, drilled and tapped for one-half inch steam pipe as near as could be determined with the appliances at hand. An investigation showed that four more cylinders of a similar type

were in the same carload of iron, but what to do with them is still an unsolved problem. The cause of the explosion is a mystery, for those who were near it at the time discovered no odor that would indicate the presence of gas, neither does the plate show any trace or sign of it. The cylinder may have been filled with compressed air at a very high pressure, and as soon as the shears flattened it, the pressure would increase, while the shears starting to cut it caused the rupture. It is an easy matter to trace the car that it came in back to its starting point, but as the scrap iron was collected from different places it may be difficult to trace the matter back until the place where these cylinders were formerly used is definitely determined, but if this can be done it will assist greatly in ascertaining the cause of the catastrophe.

▲ ▲ ▲

An Accommodation Jig.

BY A. H. CLEAVES.

The four accompanying figures illustrate a generally useful tool that can be modified in a variety of details without changing its general character.

Plane up a casting *A* and tap out three holes for ⅜ hexagon screws at 1, 2, 3.

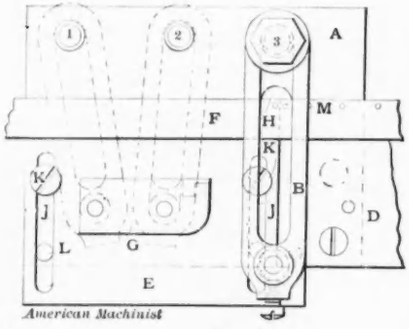


Fig. 1

Make a sliding arm *B* of cast iron for a large jig, or steel for a small one; and let this carry a screw *C*, which is adjustable up and down, and guides the drill by the hole through its center. It can be located with a guide-pin, as shown in Fig. 4, using the point in a center punch mark or the straight tip as a pin in a hole, as at *H*, Fig. 1. A number of these screw bushings, like *C*, can be made, having holes corresponding to exact size of drills; or one with a large hole in which reducing drill-holders are used. That is, a shank fitting the hole with smaller drill or tool fastened into it. The hollow screw *C* can be located and fastened in position with the set screw and brass seat in the end of *B*, or run down onto the work as a set-screw, to clamp the same when a hole is located with the point *I*, Fig. 4.

The piece *F* shows a straight piece of work, having holes stepped off in line by the use of the pieces *E* and *D*. The former has two slots *J J* and binding screws *K K* and two extra screw holes *L L*. This piece can move up close to the shoulder on *A* for a narrow strip or away for a wider one; and for the former a cut is made in *A* at *H* to allow the guide screw *C* to come over the work. The piece *D* is for holding stepping or spacing pins. One hole being drilled as at *H*, Fig. 1, is placed on the pin at *M*, Fig. 2, the piece *D* being extended if necessary to get longer spaces between holes. This piece has a flat-headed screw to fasten it to *A*, two dowel pins, and an extra place for a screw and a different piece like *D* (if holes require it) is provided for.

A number of plates like *E* can be made for holding work similar to *G*, or the latter can be held against pins in the piece *A* if more convenient. And several pieces like *B* can be used, as shown by dotted lines, for drilling as many holes.

This same arm *B*, with a higher shoulder if necessary on *A*, can be used for guiding a tap straight when used by hand; the hole to be tapped located as before with a centering pin, and the work held with a rigid clamp similar to *B*, extending from *A*.

Or a more convenient method perhaps would be to use in many cases a vise such as is in use on milling machines or for the upright drill press, having the arm similar to *B* slide and revolve on a stud with nut, which is attached to the vise.

I have seen a regular tapping table with guide like the spindle to an upright drill fitting the square on taps with sockets. A spindle with center locates the work by entering the hole to be tapped while the work is clamped to the table, then the spindle carrying tap is used.

A tool like this pays in a shop where machine work is done extensively, as it always stands ready for use and the hand wrench is used on the upper end of the spindle without any steering or square squinting.

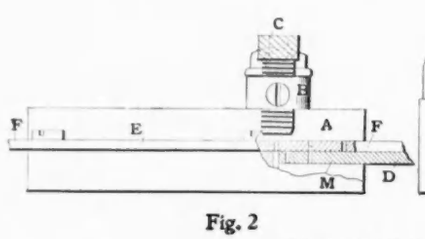


Fig. 2

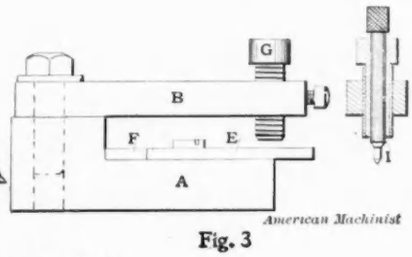


Fig. 3

AN ACCOMMODATION JIG.

Chicago, Ill.

▲ ▲ ▲

A New Inertia Indicator.*

BY WILFRED LEWIS.

About a year ago I was called upon to investigate the strength of a runway intended to carry a modern traveling crane. There was no question about the ability of the columns and girders to support the maximum load in any position, but grave doubts were entertained as to whether sufficient lateral strength had been provided to resist the inertia of the crane in starting and stopping. It can readily be understood that a mass of 50 or 100 tons moving on a runway 40 or 50 feet high must, under the influence of powerful motors, have a dangerous tendency to overthrow the structure; but just what this horizontal force actually amounted to had never been determined. In my practice I had commonly assumed it to be about 10 per cent. of the moving weight, and this assumption was based upon the proportion of load carried on drivers and the probable traction of those drivers. As traveling cranes, when properly handled, do not often slip their drivers and throw the bridges out of square, I concluded that the force exerted was generally less than the friction of wheels on rails. In locomotive service this friction is known to be about 25 per cent., and as only half of the weight of the crane comes on its drivers the maximum traction would appear to be about 12½ per cent. of the whole weight. Something should be deducted from this in starting, and the same amount added in stopping, for the journal friction in the trailing wheels; but as long as the drivers do not slip the effect is surely less than the maximum possible, and, therefore, I had assumed 10 per cent. of the weight as a rough and ready approximation to the horizontal force in question.

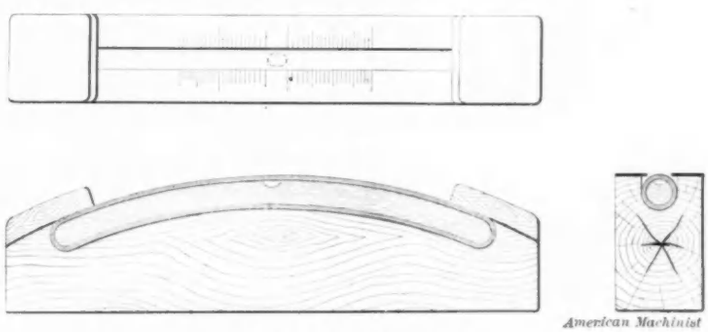
I knew, however, that traveling cranes do sometimes get out of square, and to be sure that the runway under consideration was not deficient in lateral strength, it was important to demonstrate in a practical way the actual force of inertia to be anticipated.

It was suggested by my colleague in the work that this force might be estimated from a determination of the space and time required to stop a crane running at full speed, and, accordingly, experiments were made on the most available crane at our command with this end in view. A chalk line was drawn on the wall of the building, and at the instant of passing this line at full speed the operator was instructed to stop the crane as

*Read April 16, 1898, before Engineers' Club of Philadelphia.

quickly as possible. An observer with a stop-watch noted the time in stopping, and the distance traversed beyond the chalk line was measured. These experiments indicated, as I remember, that the horizontal force exerted in stopping was about 15 per cent. of the moving weight —a value that accorded well with the maximum frictional resistances assumed. The method, however, necessitated simultaneous action and observation by two or more participants, and, as the time was measured in seconds and fractions, there was apparently room for considerable error in the result, by reason of personal differences in precision.

It was doubtful, also, whether the retarding force could properly be considered as uniform during its period of action, and even the yielding in the runway to the force put upon it seemed to claim some consideration. It then occurred to me that a pendulum attached to the crane would tend to indicate by its position the horizontal force applied, but a difficulty at once appeared in controlling its vibrations without affecting the accuracy of the readings desired. A pendulum necessarily has weight, and in moving quickly it would surely acquire momentum tending to make it overrun its true position. Endeavoring to avoid this difficulty, it then occurred to me that a spirit-level is really an inverted plumb-bob, and that in the air-bubble I had, practically, the pendulum without weight that I wanted.



AN INERTIA INDICATOR.

To indicate horizontal forces I could easily give the tube the necessary curvature and graduate it. Accordingly, I had an instrument made and graduated in degrees from which the tangent of the angle could be taken for the horizontal force required. A later form of the instrument, here exhibited, is graduated, not in degrees, but in a scale of tangents, so that the horizontal force is read at once in terms of the weight moved. No special care is required in its construction because the method of graduating takes care of any irregularities that may exist in the curvature of the tube. It is important, however, that the size of the air-bubble be proportioned to the size and curvature of the tube employed. A large bubble has some tendency to distort and overrun the mark, while a small bubble is unnecessarily sluggish in its movement. A bubble of the proper size will be quick and accurate.

On traveling cranes this indicator has shown effects ranging from 2 to 15 per cent., depending upon the method of driving. Power applied through friction clutches is more sudden in its action than a motor directly coupled, and the resistances used in the starting box naturally affect the acceleration or retardation of the motor.

In steam or trolley cars the indicator may be laid in the window sill in the direction of motion, and the force used in starting or stopping will be shown. In these cases a correction is often required for the grade of the track, which can be read off when the car is at rest. On way trains the force used in starting is about 3 per cent. and in stopping about 12 per cent., while on trolley cars about 12 per cent. of the weight is used both in starting and in stopping. The indicator shows at all times the effective accelerating or retarding force, and when the speed is constant the bubble stands at zero. As applied to traveling cranes, the sway of the runway is included in the result observed, and no corrections need be made. A swinging load introduces some uncertainties, but the maximum disturbance from this cause will probably not exceed that of the same load rigidly attached.

[To the above Mr. Lewis has added the following note:]

The development of the traveling crane has been marked by disasters clearly traceable to neglect of the horizontal forces here so plainly indicated. These have worked destruction not only to the supporting framework, but also to the crane bridges themselves. Lateral strength in these structures is a demonstrated necessity, and as such it should be subject by law to rigid inspection. In emergencies it is possible to develop a horizontal force equal to 15 per cent. of the weight moved, but in common practice the effort exerted seldom exceeds 10 per cent. This value is, however, frequently approached, and as a matter of public safety no traveling crane should be tolerated in which 10 per cent. of the vertical loading may not be exerted laterally at the same time without exceeding safe working stresses in the material. This requirement can be met in box girders liberally proportioned, but two plate girders braced together on top, with the trolley running between them, make the stiffest and safest form of crane bridge that has yet been devised. The material available for lateral strength is here utilized to the best advantage, and the strength of the upper flange as a long column is secured beyond question.

The rule for inspection here suggested is based upon the well established method of driving by one-half of the available traction, and if more than this is utilized the percentage for lateral loading should be correspondingly increased.

In addition to the uses for the indicator thus far enumerated, it might be applied to heavy reciprocating parts of machinery, such as planer tables, which often rack severely the buildings in which they are placed. It is not well adapted to rapid vibrations, because a certain amount of time is necessary to effect the indication and the instrument may be said to possess an inherent amount of lag. The same may be said of the steam engine indicator and in fact of all indicators and governors in general. They are always in pursuit of the position they should occupy at any given instant unless the impulse which they seek to measure is sufficiently prolonged. The steam engine indicator gives quite an accurate diagram of the work done in a steam cylinder at moderate speeds, but at very high speeds the cards are sensibly distorted by the lag of the recording pencil. So with the air bubble, its indications on traveling cranes and passenger cars are quite accurate, but it could not reasonably be recommended as applicable to the cross-head of a steam engine. The indicator here shown is not, therefore, of universal application nor does it seem possible to measure inertia effects perfectly by means of ponderable substances. If a machine were designed in which heavy masses were used to actuate light multiplying levers, it is conceivable that the amount of lag might be reduced indefinitely, but some lag would always remain, however much reduced, and the indicator would be imperfect to that extent. It has been brought to my attention that this bubble tube is not unlike in principle the U-tube used on locomotives as a tell-tale against the engineer when the brakes are suddenly applied with great force to make an emergency stop. Though not acquainted with this instrument, I can see that the principle must be the same, but yet there are important differences in action. The air bubble has no appreciable weight and moves like a boat in a closed tube, causing but little movement in the liquid, while in the U-tube the whole body of liquid moves together.

The air bubble is impelled by the

liquid displaced to a position where the curvature of the tube is normal to the resultant of gravity and acceleration. The force which moves the bubble is proportional to the weight of displaced liquid, and this is several hundred times the weight of the bubble of air, while in the U-tube the liquid itself moves as a whole, acquiring much greater momentum.

To prevent an overrun in position the U-tube would have to be contracted somewhere in its cross section and for the same length of scale it would certainly be more sluggish in action. Nevertheless the latter has an advantage in the possibility of recording maximum effects, and in some cases such an instrument would be preferable to one requiring close observation.

My indicator does not do everything and its field of usefulness may not be very broad, but as a new and convenient device for measuring inertia effects it excited some interest in the Engineers' Club of Philadelphia, and a further account of it is here offered in the belief that it may be of interest to the readers of the "American Machinist."

▲ ▲ ▲

Diagrams for Compressed Air.—Horse-Power and Temperature.

BY J. E. JOHNSON, JR.

The diagrams which accompany this article were originally platted to supply a need felt by the writer for a quick and convenient means of obtaining fairly accurate solutions of two of the most important questions occurring in connection with compressed air, viz.: How much power will be required to compress a given number of cubic feet of free air to a given pressure; and, What will be the temperature reached at the end of compression, neglecting the cooling effect of the water jacket?

The quantity of free air taken as a basis was 1,000 cubic feet at atmospheric pressure, taken as 14.7 pounds per square inch and at 69.5° Fahr., under which conditions 1,000 cubic feet weigh exactly 75 pounds. The upper solid line of the first diagram, marked "H. P. 1 Stage (Adiabatic)," Fig. 1, shows how many horse-powers are required to compress this quantity per minute adiabatically to all gage pressures from 0 to 300 pounds per square inch.

The lowest and heaviest of the solid lines marked "H. P. Isothermal" gives, in a similar way, the power required if the compression were isothermal, which it never is and cannot be, this curve being added for purposes to be explained later. The upper curve of all, a broken line marked "Temp. 1 Stage (Abiabatic)", gives the temperature corresponding to each pressure. This curve and the one first mentioned are the bases for all the others in both diagrams, except the power curve for isothermal compression.

[At this point Mr. Johnson gives the formulas from which the horse-power curves are computed, but as these are essentially the same as those recently given by Mr. Halsey they are omitted.—ED.]

If anyone wishes to convert the horse-power obtained from the diagram into M. E. P. he has only to divide by

$$\frac{144}{33} = 4.36.$$

The formula for the temperature resulting from compression is

$$T_2 = \left(\frac{P_2}{P_1}\right)^{\frac{k-1}{k}} \times T_1$$

In which, of course, T_1 stands for the initial absolute temperature, and as this is (in Fahrenheit degrees) 460.6 degrees more than the temperature Fahrenheit, and as our assumed initial temperature is 69.5 degrees, we have $T_1 = 530.1$, and from T_2, as given by the formula, we must subtract 460.6 degrees to obtain the final temperature on the Fahrenheit scale. The initial temperature 69.5 degrees was taken because, as stated, at that temperature and atmospheric pressure 1,000 cubic feet of air weigh 75 pounds, which is a very convenient figure in all calculations involving the weight of air handled, and because it is probably about as low as the temperature of the air ever is, even under good conditions, at the beginning of compression, for, during inlet, it must always be heated up to some extent by the cylinder walls, even when they are water-jacketed.

The diagrams will be seen to have two rows of figures along the base line, one of them occurring at the even divisions given the gage pressures in pounds per square inch. The other on lines extending below the bottom of the diagram, and not coinciding with the regular divisions represents absolute pressures in atmospheres, or multiples of 14.7 pounds per square inch, and as the initial pressure is one atmosphere these lines give, at the same time, the ratio of the initial and terminal pressures

$$\frac{P_2}{P_1}$$

The values of $H\ P$ and T_2 have been calculated by logarithms, from the formulas, for each of the values of

$$\frac{P_2}{P_1}$$

from 1 to 21 and platted to give the "1 Stage" curves. Also the power required if the compression followed the isothermal line has been calculated for the same values of

$$\frac{P_2}{P_1}$$

according to the formula

$$H\ P = \frac{2117}{33}\left(\log.\ \frac{P_2}{P_1}\right)$$

in which

$$\log.\ \frac{P_2}{P_1}$$

is, of course, the Napierian logarithm.

To show the saving in power due to compressing in stages, with inter-cooling back to the (original) initial temperature, and the maximum temperature reached in such compression, the curves "H. P. 2 Stages," "Temp. 2 Stages," "H. P. 3 Stages" and "Temp. 3 Stages" have been drawn, the former starting at 50 pounds per square inch and the latter at 100. These are drawn on the assumption that the compression is equally divided in the different cylinders; that is, that the ratio of the initial and terminal pressure is the same in all the cylinders. This may be very readily shown to be the most economical by the diagram.

Since the total ratio is the product of the individual ratios, and since $P\ V$ is the same for each stage, if T_1 is the same, which we have assumed it to be, it follows that to compress to any given ratio of pressures in two equal stages requires twice the power needed to compress to the square root of that ratio in one. In like manner to compress in three stages requires three times the power needed to compress to the cube root of the given ratio; similarly also for four stages.

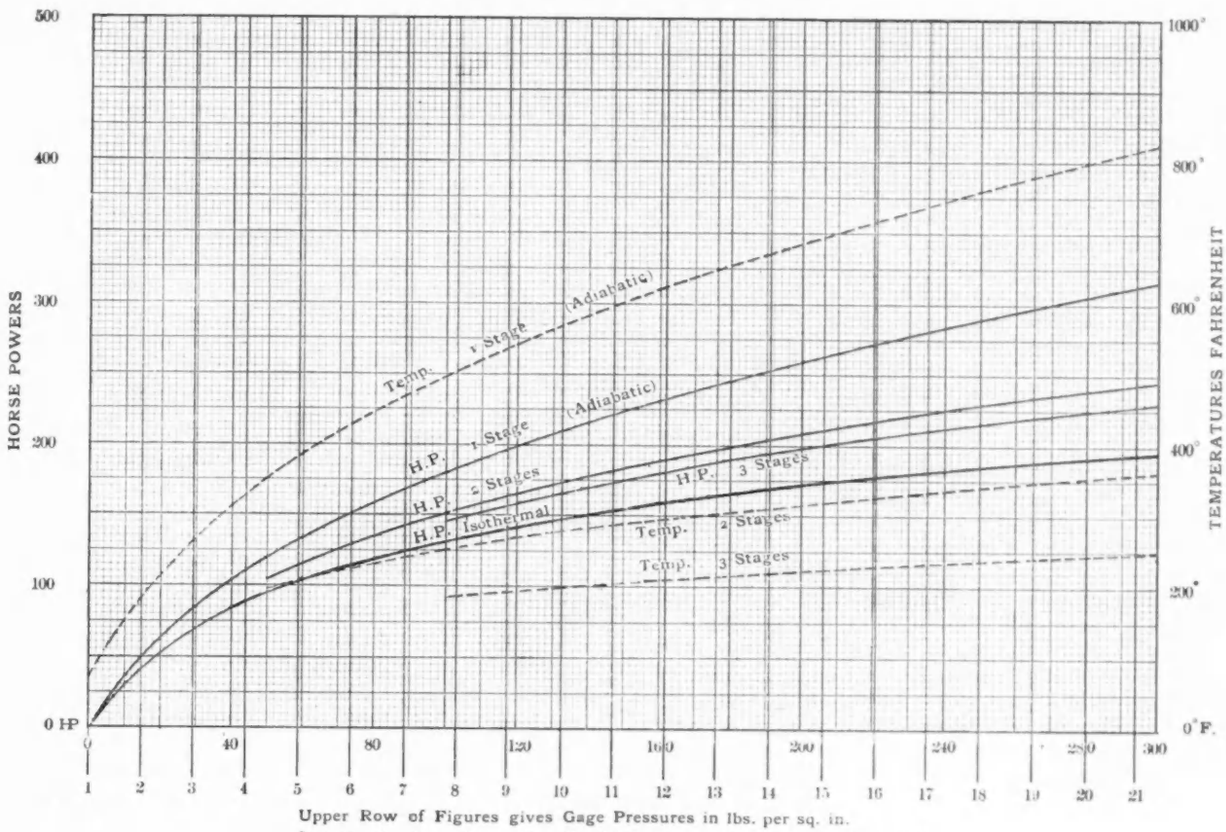
With this explanation let us return to the proof that the most economical stage compression is with equal pressure ratios in all the cylinders, and take for example the case of compression to 16 atmospheres in two stages. If the ratios of the two stages are equal, four each, the power required $= 2 + 109 = 218$ H. P. If we try five and 3.2 for our ratios we find it requires $87 + 131.5 = 218.5$ H. P. For ratios 2.5 and 6.4 it requires $67.5 + 158 = 225.5$ H. P., and for 2 and 8, 232 H. P., while a single stage requires 272. Thus it will be seen that, while the difference is slight for quite unequal ratios, the power required is really least when they are equal.

The temperature curves are simply those of the maxima reached in the cylinders, which are the same in all for equal stage ratios, since T_2 depends only on T_1 (which is assumed constant) and

$$\frac{P_2}{P_1}$$

and must be the same when that is the same. These curves for compound compression do not represent the course of the rising temperature during compression, as the single stage temperature curve does, which temperature increases with the pressure *in all cases* according to the original temperature curve and reaches in each cylinder the maximum given by these second and third curves.

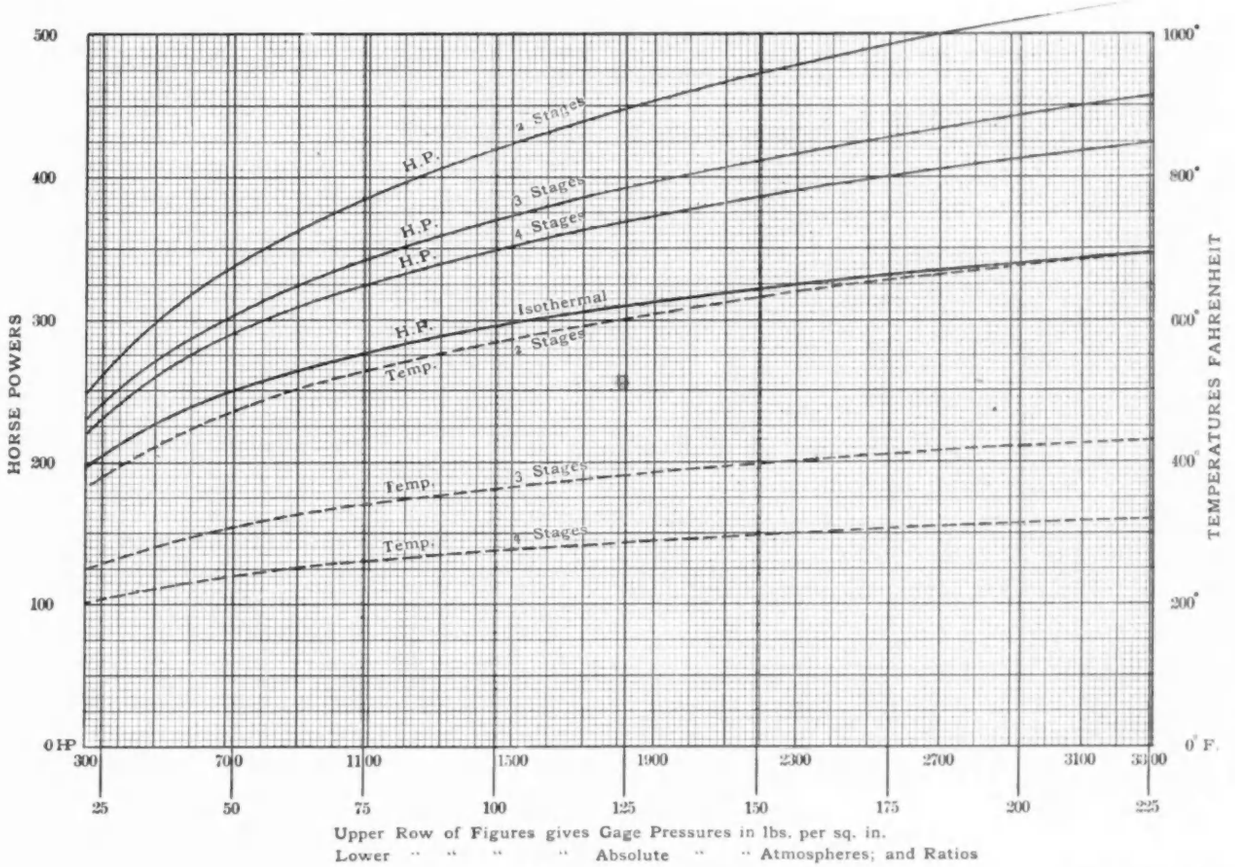
The second diagram, Fig. 2, is of precisely the same kind as the first, but for high pressure air, from 300 to 3,300 pounds per square inch. The pressures in atmospheres are added to the second diagram in the same way as



Upper Row of Figures gives Gage Pressures in lbs. per sq. in.
Lower " " " " Absolute " " Atmospheres; and Ratios

Fig. 1

American Machinist



Upper Row of Figures gives Gage Pressures in lbs. per sq. in.
Lower " " " " Absolute " " Atmospheres; and Ratios

Fig. 2

American Machinist

DIAGRAMS OF HORSE POWERS AND TEMPERATURES OF COMPRESSED AIR.

to the first, but are only given for every 25 atmospheres, and represent ratios, with 1 atmosphere as a basis, as in the first diagram. The curves for single stage compression are not carried out on this diagram, because the temperatures reached and the power unnecessarily expended are far too great at 300 pounds to justify anyone in using single stage compression to that pressure, and above that it is practically out of the question. Anyone who wishes to use it ought not to have any assistance in the form of diagrams or otherwise. To this diagram, however, have been added the curves for four stage compression, which might be used at the highest pressures with a theoretical saving of 30 horse-power on 450, or about 6 per cent. It will be noticed that the curve for each stage shows a much smaller gain over the last than the last did over the one preceding it, and it is perfectly evident that no practicable number of stages will enable us to come very close to the isothermal power curve. It must be remembered also that in these curves no allowance is made for friction, for loss of pressure in forcing the air through the inlet and outlet valves of each cylinder, for clearance and other items of a very practical nature, such as repairs and maintenance, first cost, space occupied and the like. When these are considered one feels very much inclined to doubt whether it is ever wise to use more than two stages below 300 pounds pressure and more than three below 3,000.

To show how the diagrams agree with practice we may take as an illustration the cards given in the issue of March 3, according to which it would require 164 horse-power in the compressor cylinders to compress 1,000 cubic feet per minute to 110 pounds gage, while according to the present diagram for two stage compression it would require 159. The difference will be seen to be in the overlap of the two diagrams and the area below the atmospheric line in the low pressure card, while a slight saving is made by the fact that the actual curve, in the upper part of its length, falls a little below the adiabatic. This, however, is small compared with the losses mentioned. This comparison gives a very good idea of the degree of correspondence that may be expected to obtain between the diagrams and good practice.

The important point always in questions connected with compressed air is the ratio of pressures

$$\frac{P_2}{P_1}$$

and after that the value of $P\,V$. In regard to the latter it is well to remember in connection with the present diagrams that a cubic foot of air under atmospheric conditions weighs .075 pounds and that the quantity considered by the diagram is in all cases 75 pounds. This will simplify many calculations. We can thus readily analyze Mr. Richard's method for increasing the efficiency of compressed air. We see that the ratio of the absolute pressures working from 200 pounds gage down to 100 is a trifle less than

$$2\left(\frac{43}{23}\right)$$

for which the efficiency of compression as compared with isothermal by the diagram is

$$\frac{84}{95}$$

and the efficiency of utilization, if we may use the term, is the same, or a total efficiency equal to this fraction squared, or 78 per cent., while the efficiency of compression to 100 pound gage from 1 atmosphere is

$$\frac{132}{180}$$

and the total efficiency the square of this, or 54 per cent. We can also see that with a ratio of two, starting with atmospheric pressure, or working between atmospheric pressure and 15 pounds gage, the same weight of air would transmit the same amount of power with an equal efficiency, but the area of all pipes and cylinders would have to be

$$\frac{115}{15} = 7.7,$$

almost eight times as large, while the use of such low pressures is, of course, impracticable. The illustration, however, points out the fact that efficiency is a matter of the ratio of the pressures, and is high under the circulating system because that system, while preserving the desired net difference between high and low pressures, reduces the ratio between the two. The high pressure system has the further advantage, as shown by Mr. Richard's diagrams, that where the expansive force of the air cannot be employed, the area under the expansion curve, which is wasted, is a very much smaller percentage of the whole than in the ordinary system; this is especially important in such work as operating hoists, presses, etc.

One cannot help wondering if this system could not be very advantageously employed in connection with the ordinary one, where there was a variety of work to be done by compressed air, using the high pressure air for such purposes as do not admit of expansive working, and taking the air from the return pipe of this system for such engines, etc., as could use it expansively. This would be the same in effect as compound expansion, and would save a large part of the piping required by the high pressure system alone.

The correspondent who sent the excellent two stage cards Mr. Halsey analyzed a few weeks ago asked one question which brings up a point I have never seen alluded to in any of the articles hitherto bearing on this subject; that is, the index of the compression curve and the way to determine it. All compressors, I think, without exception give a card with a varying (decreasing) index, because the air is always colder than the cylinder at the beginning of compression and is warmed up by the cylinder walls, so that its pressure is increased faster than it would be by compression alone up to the point where the temperature of the air equals that of the cylinder, from whence it loses heat to the cylinder, and its pressure rises less rapidly than it would by compression alone. In low pressure compression, where the cylinders are not jacketed, the curve first rises above the adiabatic and then falls back to it, while the jacketed cylinders, or those with water injection, it always falls below the adiabatic, but more rapidly, as its increasing temperature causes the heat to flow from it more rapidly. This is illustrated in the diagrams mentioned. The curve at first coincides exactly with the adiabatic drawn by Mr. Halsey, and then, about half way up, it begins to fall away from it.

For the benefit of those who may wish to investigate the question of indices a rule for finding the index at any one point is given, which is original, and, as far as the writer knows, new. It is derived by the use of a little calculus, but requires nothing but a pair of triangles and a rule for its application, not even a table of logarithms, which is sometimes an advantage.

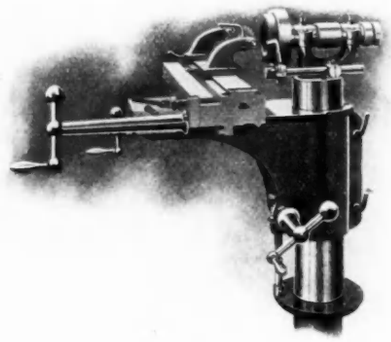
To determine the index at any point we have only to draw a vertical through it down to the (absolute) zero pressure line, and from the foot of this draw a line parallel with the tangent to the curve at the given point until it intersects the line of zero volume. The length of this intercept divided by the length of the vertical through the point gives the value of n. This method is only available where the curve is entirely regular and smooth and sharply defined enough to make the slope of the tangent ascertainable with accuracy. For the average index for the whole curve, or points some distance apart, the regular method as explained by Mr. Halsey is much the best. As far as my experience goes, for practical value, indices are good things to let alone.

▲ ▲ ▲

The experiments upon materials at low temperatures which have been made possible by the advent of liquid air develop some unexpected results. A ball of india rubber cooled to the temperature of the air becomes brittle, and if dropped on the floor flies into a thousand (more or less) pieces, while a ball of lead will rebound, having acquired a remarkable increase of elasticity. Lead also makes a very respectable spiral spring at a temperature of 200 or 300 below zero.

A New Cutter Grinder.

We present herewith three views of a new universal cutter grinder which has been designed to do in an efficient manner all that large class of grinding now understood to be included in cutter grinding, and which far transcends the original conception of that work.



BACKING OFF A CUTTER.

Lack of space prevents our showing the machine in all the various positions of which it is capable, but those who are familiar with such machines will readily perceive its adaptability to a wide range of work.

The knee swings entirely around the column, so that grinding may be done either by the face of a cup wheel, or on the periphery of an ordinary wheel, as may be preferred, at either end of the spindle. With the fixtures shown and also with a vise and other special fixtures, not shown, internal and external cylindrical and taper grinding and surface grinding can be done. There is also a special fixture for grinding relieved milling cutters.

The wheels are fitted to the spindle by tapered centers, insuring their truth wherever put in place, and the vertical adjustment of knee (7 inches) is supplied with micrometer adjustments, as is also the tooth-rest.

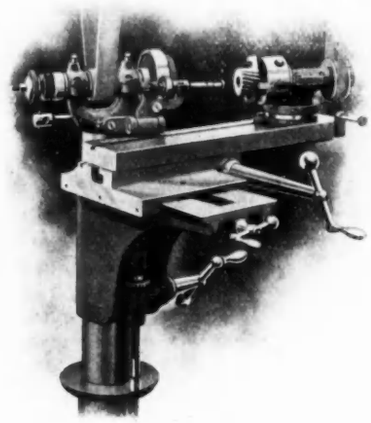
The machine takes 20 inches between centers—19 inches where the work is revolved, has a platen movement of 18 inches, cross-movement (to and from the column) of 6 inches; will grind cutters up to 6½ inches diameter on center and to 11 inches on the cutter holder. It is made by Wells Brothers & Co., Greenfield, Mass.

▲ ▲ ▲

Extensions of Niagara Falls Power Plants.

The original installations of the two well-known power companies at Niagara Falls have proved so successful that both plants are being enlarged to a considerable extent. The extensions are well under way, and the power stations are the scenes of great activity while the new machinery is being placed. The additions to the plants call for an immense expenditure, as all the work is being done on the substantial lines originally planned.

In the case of the Niagara Falls Power Company they have extended their wheel-pit so as to accommodate a total of ten 5,000 horse-power turbines, the depth of the new section of the pit being 179 feet. The original section of the power house was about 140 feet long, and it has been extended 286 feet, making the present length about 426 feet, which length covers the entire wheel-pit. The average width of the pit is 20 feet, and this is increased at the top to make room for masonry walls 6 feet wide. These walls are carried down to solid rock, the width between them being 21 feet. The penstock mouthpieces were all placed when the wall was built, in order that no masonry would be necessary when the additional turbines and dynamos are installed. The size of the openings directly under the dynamos has also been increased. Still another change in the new installation as compared with the original work is found in the method of supporting the girders in the pit. In the first section of the pit the ends of the girders are built right into the walls, whereas in the new section the girders are supported on castings placed in the walls. In installing the new turbines a suggestion of Dr. Coleman Sellers has been adopted. In the original installation the turbines are supported on girders, but in the section of the pit the wheelcase and lower penstock elbows of the installation will have projecting ribs supporting them on castings, which in turn are bricked into the walls. Still another change made in the new installation, as compared with the old, is to be found in the method of obtaining current for exciting the fields of the generators. In the original power house this current was obtained from 200 kilowatt rotary transformers which stand at one end of the switchboard structure. In the new section of the pit four small turbines will be arranged to operate four exciters to be placed on the floor of the power station, thus assuring an absolutely independent source of supply.

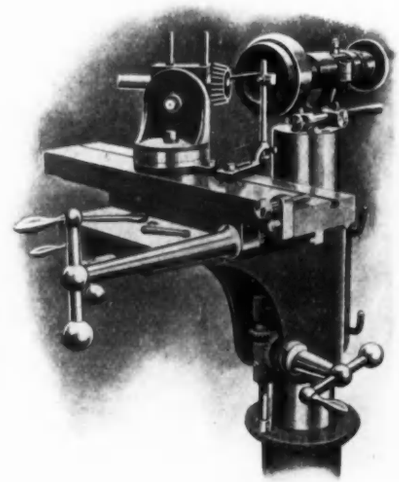


INTERNAL GRINDING.

There are at present in this power station three 5,000 horse-power generators and three 5,000 horse-power turbines in full operation, while the fourth generator and turbine have been placed in position and tested. This makes practically 20,000 available horse-power, which amount is to be increased by additional generators and turbines to a total of 50,000 horse-power. This will necessitate the installation of six more turbines and dynamos, each one ranking in a class of the largest machines of the kind ever built. The generators are the product of the Westinghouse Electric & Manufacturing Company, of Pittsburg, while the turbines are made by the I. P. Morris Company, of Philadelphia. These firms built the generators and dynamos of the original installation.

The interior of the power house, especially the dynamo room, presents a busy scene. In the center, toward the west end, a new switchboard structure is being erected, and here and there are new dynamos in course of erection. The floor is almost buried from sight by boxes and other packages containing new machinery. A 50-ton traveling crane, driven by electricity, aids materially in lifting and placing the heavy parts of the installation. The architecture of the extension is of the same beautiful style of the original section of the building, the material used being Queenstown limestone. The resident engineer is William A. Breckenridge. L. B. Stillwell is the electrical director, while Paul M. Lincoln is the electrical superintendent.

During recent years the Niagara Falls Hydraulic Power & Manufacturing Company have made many improvements about their power possessions at the Falls. This company owns the oldest power privileges at Niagara, and the



GRINDING AN ANGULAR CUTTER.

water supply for their power house is diverted from the upper canal, the length of which is about 4,400 feet, extending to the high bluff of the lower river. The width of the canal at the entrance is about 250 feet, narrowing to 100 feet in 400 feet of its length. From this point down to the basin on the bluff it is about 70 feet wide, but the company own sufficient land to widen it to 100 feet if they desire. For about 30 feet of its width the canal is 8 feet deep and for the remaining 40 feet it has a depth of 14 feet.

The power house of this company is located at the water's edge in the gorge. The original section of the building is 60 feet long by 100 wide. In it are installed eight generators operated by four turbines. These turbines were made by James Leffel & Co., of Springfield, Ohio, and the generators are direct connected to them. Six of the generators supply power for the lower works of the Pittsburg Reduction Company, while the other two furnish power for operating the electric road that runs through the gorge; also for other purposes. To this station has been built an addition of the dimensions of the original building, making the present dimensions of the building 120x 100. The materials used in construction are stone and iron. In this new part of the station are to be installed five wheels of 2,500 horse-power each, the first of which has been ordered and made by R. D. Wood & Co., of Philadelphia. It is now being installed. To this wheel will be connected a generator made by the General Electric Company to supply current for operating the new chlorate of potash plant of the National Electrolytic Company, located on the high bank above. This plant is preparing to start operations as soon as a supply of current is ready for it. The generator will be of 1,200 horse-power. It will have fourteen poles and will make 257 revolutions per minute, giving an output of 5,000 amperes at 175 volts. It has been most carefully designed, in order to cope with the severe work of the electrolytic process. This wheel will also have connected to it an alternating current dynamo of 700 kilowatts output capacity at 2,200 volts pressure, to be operated at 250 revolutions per minute and at 125 cycles a second. This machine is to be used by the Buffalo & Niagara Falls Electric Light & Power Company. Two small turbines are to be placed to operate two exciters designed to furnish current to the fields of the generators. The additional large turbines will be installed as demand makes it necessary.

For this installation the water flows from the upper river through the main canal to a basin located about 300 feet back from the edge of the bluff. A short connecting canal takes water to a forebay situated at the edge of the bank, and from this forebay huge penstocks carry the water to the wheels in the gorge below. In the original installation the penstock is erected close to the bank, but in the new part the penstock rises from the power house in column form, and with an imposing appearance. This penstock was made by Struthers, Wells & Co., of Warren, Pa. It opens into the forebay with an elliptical bell mouth about 20x11 feet. Leaving the forebay it extends out horizontally about 60 feet, then runs vertically about 200 feet down to the power house. It is 11 feet in diameter until it passes beneath the power house, where for about 50 feet it is 13 feet in diameter until it passes one or two wheels, when it reduces to 7 feet, and finally tapers off into a cone 18 inches in diameter, ending in an air chamber 4 feet in diameter and 15 feet high. The steel used in it varies from 5-6 to 1⅛ inches in thickness. The locality about the plant is very busy, and every possible effort is being made to get the new installation in early operation. Wallace C. Johnson, M. Am. Soc. C. E., is the chief engineer of the company.

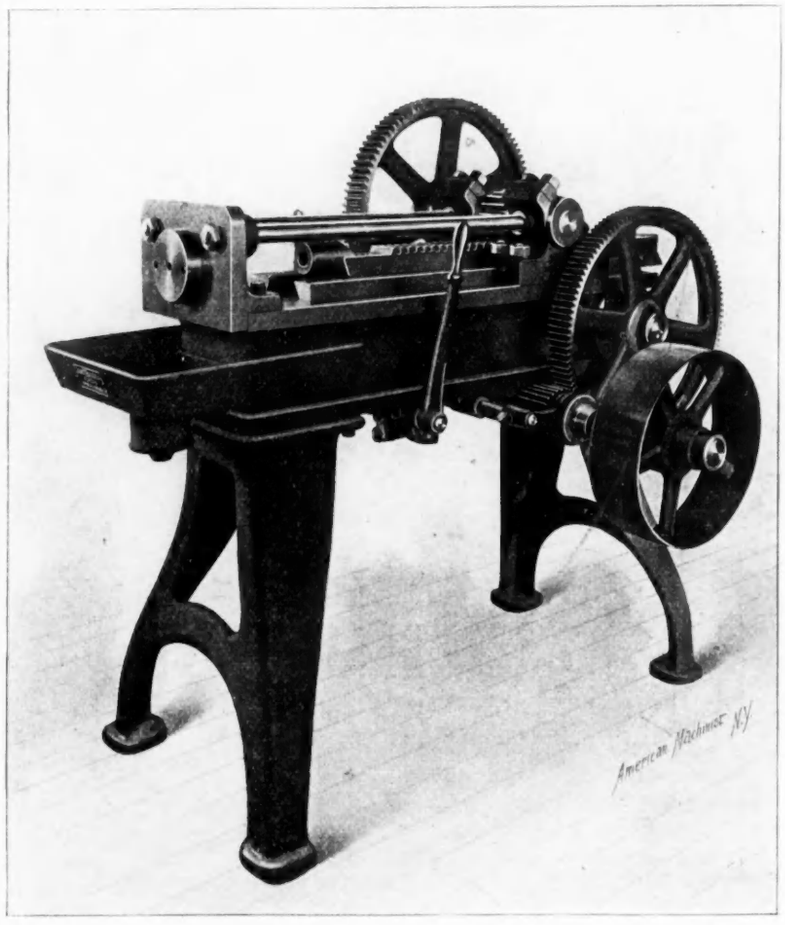
▲ ▲ ▲

According to official figures wages of men making machinery declined 34.47 per cent. between 1881 and 1897 in Massachusetts. Cost of groceries, etc., declined 6.67 per cent. in the same period.

Improved Broaching and Key-seating Machine.

The accompanying illustration is of an improved form of broaching machine, which is designed to broach holes of irregular shape in forgings or castings, or, with suitable appliances, to cut keyways taper or straight from ¼x⅛ inch to ⅝x 15-16 inch.

The broaching machines previously built by this firm, John T. Burr & Son, 32 South Sixth street, Brooklyn, N. Y., have been arranged to work by square threaded screw and nut. The present machine, as will be perceived,



BROACHING AND KEY-SEATING MACHINE.

works by a train of gearing which is connected to a steel rack formed upon a horizontal ram working in a horizontal slide. The rack is in line with the broach, so that the pull is direct, and this pull is resisted by the bed of the machine and by the two wrought columns seen above it. The machine is designed to work at a cutting speed of from 5 to 10 feet per minute, depending upon the nature of the material. There is an automatic stop upon the slide which releases a clutch and stops the broach at any desired point, and this stop can be so arranged as to auto-

matically return the slide to its original position if desired.

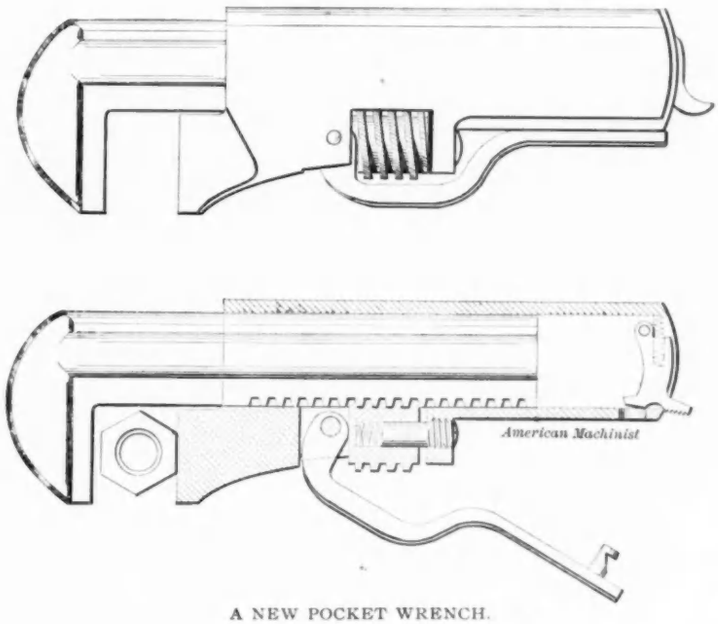
The cutter bars, bushings and keys are the same as we have illustrated in a previous issue, and the present machine is made with beds 42 or 54 inches long, giving a travel of 24 and 36 inches, respectively.

A suitable drip pan is arranged to receive and take care of chips and oil, when the latter is used, and the machine is designed to be amply strong and powerful for work within its range.

▲ ▲ ▲

A New Pocket Wrench.

The cut shows a new pocket wrench for bicycle and other service. With this wrench the user will have no further excuse for mutilating nuts or bolt heads, as a tight and close grip is readily secured, and at the same time the wrench is more readily released and applied again to another side of the nut or bolt



A NEW POCKET WRENCH.

than has heretofore been possible. The cuts show very clearly the construction and operation of the wrench. The lower figure shows the wrench with cam lever open ready to engage the nut or other piece to be grasped. The sliding jaw is screwed up by the knurled nut in the usual way until it nearly grasps the nut; the cam lever is then pressed toward the handle and the nut is closely gripped. Releasing the lever frees the wrench so that it can be slipped off and then on to another square and so on. The lever, when pressed entirely down, is latched and fastened, but flies open upon touching the thumb lever at the end of the handle. The movement of the jaw by the cam lever is not over 1-16 inch, the last of the movement being very slow, so that if desired the wrench may be made to pinch like a vise. The wrench is the invention of Mr. C. E. Billings, and is manufactured by the Billings & Spencer Company, Hartford, Conn.

▲ ▲ ▲

Packing Piston Rods.

BY W. H. WAKEMAN.

One of the most common causes of scored piston rods is lack of proper lubrication. As a rod travels back and forth at from 300 to 1,000 feet per minute a great deal of friction is developed, and although the steam is supposed to be saturated with oil this is not always sufficient, and to overcome the difficulty some engineers use a swab dipped in cylinder oil once an hour, or perhaps once in half an hour, throughout the day; but while this is very good, as far as it goes, it does not go far enough. In the case of a crank pin or a main bearing we think it necessary to have a sight feed oiler that delivers several drops per minute, and yet those bearings are not heated by steam, neither are the surfaces kept so close together that steam at 100 pounds pressure cannot work out between them, as in the case of a piston rod. It is evident that a sight feed oiler should be provided to drop oil on the rod every minute that the engine is in operation, but if the proprietor will not furnish this oiler the engineer usually thinks that he cannot do it; therefore no oiler is in evidence. I am satisfied, however, that in scores of cases such oilers would be furnished if the proprietors understood the benefits to be derived from them.

Certain kinds of packing have a tendency to stick to the rod where they are in contact over night, which destroys the packing and scars the rod, but I have never found a case of this kind where a sight feed oiler dropped cylinder oil on the rod throughout the day. Where a rod is exactly the same diameter throughout its length, and the engine is in perfect alignment, it is not a difficult matter to select a packing that will make a good joint without excessive pressure, but if the rod does not travel in a perfectly straight line then some form of packing that is very elastic must be used so that it will follow the rod. Sometimes a packing will be very elastic for a short time and then become hard and stiff. Under such conditions it is perfectly natural to try to stop the leak of steam by screwing up the gland, but this only affords temporary relief, and at the same time it burns the packing so that the inner surface of it is hardened and cuts the rod.

One advantage with some forms of metallic packing that are in the market is that the engineer cannot screw the nuts on the stuffing-box gland down hard enough to do any damage, while others are made wedge shaped so that any excess of pressure on the nuts will ruin either the packing or the rod, whichever is the most vulnerable. These metallic packings are rather expensive at first, but under any ordinary conditions they are cheaper in the end than fibrous packing. Some of the latter are made in the form of a wedge so that it is quite possible to bring a very great pressure to bear on the rod by means of them, if the gland is forced down more than is necessary; therefore the engineer should use good judgment in this respect. Other styles are made in one piece, and are designed especially for the particular stuffing-boxes that they are intended to fill, in which case there is no danger from the effects of the wedge form; but this kind is almost always very solid and compact, so that the nuts should be left loose until the heat has had a chance to expand the packing to its full extent, and then they should be tightened only enough to stop the leakage of steam.

When several rings of packing are to be used in a stuffing-box they should not be long enough for the ends to come into contact when first put in place, for if this is allowed there is no room for expansion, and the packing may be ruined and the rod scored. If four or more rings are to be used they should be placed to break joints, so that no steam can leak past them. Where round packing is used it is well to get a size larger than the space in the stuffing-box calls for, and flatten it down until it will go into place easily, but it should not be laid on an anvil where there are iron chips and flattened by a hammer that is not clean. If the rings do not go into place easily nothing harder than a hickory stick should ever be used in driving them in. After each ring of packing is started in the gland should be used to force it to its place, and when necessary to remove the packing the nuts should be loosened while the engine is running and the rings started

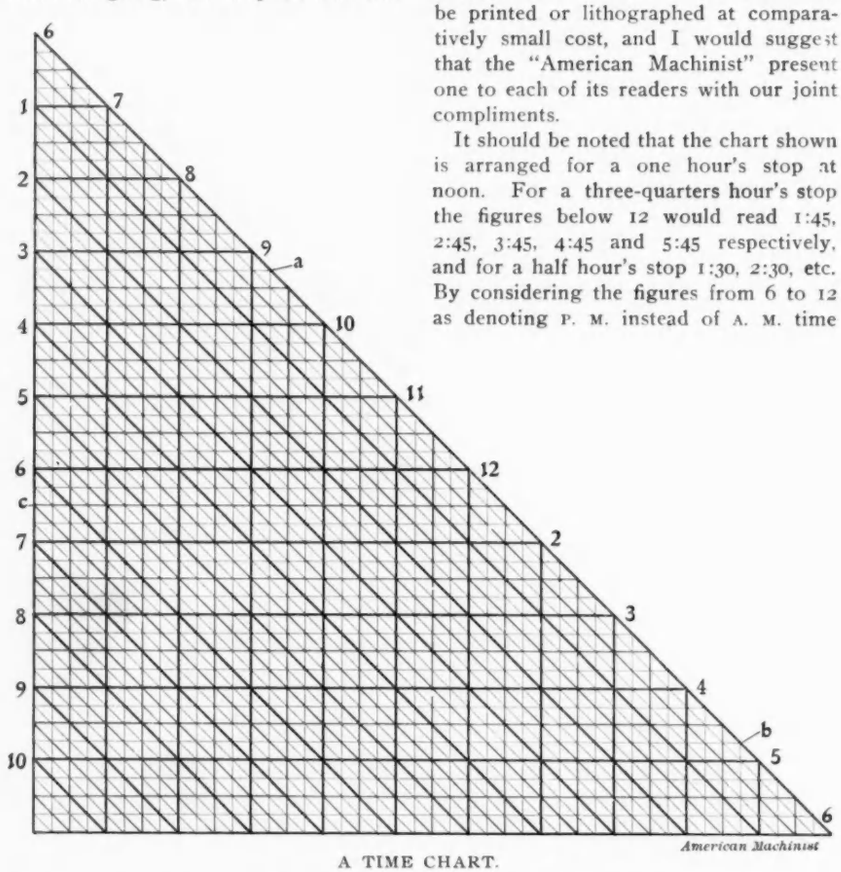
out by the action of the steam and of the piston rod; then, after shutting down, the crank should be placed nearly on the center and a full head of steam admitted to the crank end, as this will usually blow the old packing out and save much unpleasant labor with packing hooks. Some engineers screw up the nuts holding the gland in place without noticing whether all are turned up alike or not. It is a good plan to use a light when engaged in such work, and to be sure that the open space around the rod is equalized, and it is better to do it when the engine is shut down. I have adopted the plan of removing piston rod packings at stated intervals, whether they appear to be worn out or not, and find that it works well, as the rods are kept in excellent condition and the cost of packing is but slightly increased, so that it is a paying investment.

▲ ▲ ▲

A Time Chart.

Editor American Machinist:

The accompanying cut represents neither a checkerboard nor a bit of oilcloth designing, but a quick and convenient means for finding the length of time spent on a given job.



A TIME CHART.

The diagonal series of figures represent the hours of the day from 6 A. M. to 6 P. M. and apply to both the vertical and horizontal lines. The figures at the left refer to the diagonal lines only and show the time worked for any period of the day. The heavy lines stand for even hours and the light lines for quarter hours.

Rule—To find the time spent on any job read the number opposite the diagonal which passes through the apex of the triangle whose sides are formed by the lines representing the time of beginning and of leaving off work.

Example—If a man begins a job at 9:15 and finishes at 4:45, how long has it taken him to complete the work? Drop down the first light line *a* to the right of 9 to the first light line, *b*, above 5, and then read 6:30 at the end of the diagonal, *c*, passing through the intersection of these two lines.

It ordinarily takes a workman anywhere from one to three minutes to make such calculations as above, according to his mental capacity. Three minutes a day per man means a loss of five hours a day for each hundred men. Taking the average rate of wages at 20 cents per hour and figuring general expense at 100 per cent. of wages, a shop employing 500 men would lose over $3,000 yearly through this one heretofore apparently unappreciated leakage. The charts may be printed or lithographed at comparatively small cost, and I would suggest that the "American Machinist" present one to each of its readers with our joint compliments.

It should be noted that the chart shown is arranged for a one hour's stop at noon. For a three-quarters hour's stop the figures below 12 would read 1:45, 2:45, 3:45, 4:45 and 5:45 respectively, and for a half hour's stop 1:30, 2:30, etc. By considering the figures from 6 to 12 as denoting P. M. instead of A. M. time the chart is equally useful for night work.

H. M. NORRIS.

[The diagram, which is interesting and somewhat ingenious, is hereby presented to our readers, as suggested. Our correspondent must have been unfortunate in his shop associations, as he has evidently struck an exceptionally thick-headed and slow lot of shopmates. There is no probability that the above chart would ever save a cent of money for any shop proprietor, so far as its use by the men was concerned.—ED.]

▲ ▲ ▲

Letters from Practical Men.

The Stretch of Bolts and Nuts—Jacket on Steam Separator.

Editor American Machinist:

I am thinking that Tecumseh Swift is wrong in his consideration of the above-mentioned question as set forth in the issue of June 9.

An error was made in my original sketch, and in the illustrations from it, in showing the V thread in place of the Sulzer thread, out of which grew the discussion. But as neither of us has taken notice of that error, let it be understood that the thread is a square one, with rounded bottom.

I argue that the stretch of a bolt will follow the law of a spring, which is certainly correct within its elastic limit. That is to say, if 200 pounds will stretch it a certain distance, 400 pounds will stretch it just twice as far. Assume the bolt to be 1 inch, 8 pitch, square thread, and the nut 10 threads long, the load, 1 ton, equally distributed on all the threads. The upper thread of the bolt would have 200 pounds to hold, and stretch, say, one-ten-thousandth, the second thread 200 pounds more and would stretch one-ten-thousandth more, and so on, each additional 200 pounds would add its equal amount, so that the whole thread would have stretched one-thousandth of an inch and equally all the way down, and therefore instead of the pitch being one-eighth inch it would be an even pitch of one-ten-thousandth more. In like manner the pitch of the nut would be uniformly increased, and the two fit as perfectly as when without strain. A plotted diagram of the elongations would be in each case a straight line, and two straight lines will fit together.

Why the Sulzers should adopt the square thread with the round bottom seems strange, and yet I fancy it is about the only form in which a tap can be made and ground to pitch after hardening.

In the editorial remarks on the discussion at the Niagara Falls meeting the statement is made that if the planished steel jackets on the steam separators get about as hot as the pipes the intervening non-conductor can do no good. If the efficiency of the non-conductor, such as cork and magnesia, is due, as claimed, to the fact *that the heat makes its way through very slowly*, then why does putting on the steel jacket make it pass through faster? Or do you take the ground that the heat would pass through the confined air as slowly as through the non-conductor? My idea now is that the heat as it works

through the common non-conductor is, owing to the rough outer surface, rapidly carried off by the air, and that the greater the difference between the temperature inside and out the faster the heat would pass, as is true in other cases. When the steel jacket is put on, which has very little capacity for heat, and gives it up very reluctantly, it does not take very long for it to get hot, and then it stays so. If the flow through the non-conductor is according to the law, then the steel jacket must do good as Professor Robinson claimed, for the flow through the non-conductor would be less with the heat nearly equal on each side. This is only a theoretical consideration of the case, and a thorough test of the thing would be a lot more valuable and convincing. JOHN E. SWEET.

[Our remarks regarding the usefulness of the non-conducting material were based upon Professor Sweet's original statement that the planished jacket got "just as hot as the separator;" not "about as hot." Of course, if the outer steel covering does actually attain the same temperature as that of the separator from which its heat comes, then it is of course evident that it could get no hotter if the non-conducting material were not there at all. And it is of course true also that at a given temperature of the jacket it will pass heat into the atmosphere at a given rate, and therefore if its temperature is the same without the non-conducting material as with it the heat transmitted to the atmosphere is the same, and the non-conducting material can do no good. As a matter of fact, it is probable that measurement of temperatures would show that the temperature of the separator is somewhat higher than that of the planished steel covering.—ED.]

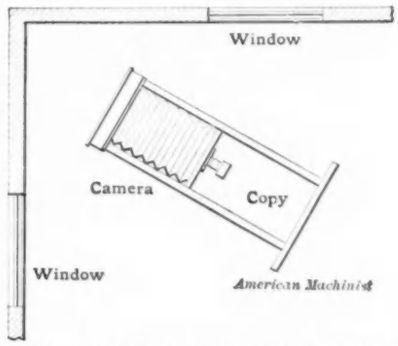
▲ ▲ ▲

Photo Copying Drawings.

Editor American Machinist:

I have received numerous letters referring to my article on this subject in the "Machinist" for April 21, inquiring the expense of such an outfit. The following figures will give an idea of the cost. Whether it be *expensive* or not will depend on the volume of business and the character of the work.

The size of the camera governs the price in a great measure. If the standard office size for drawings is impracticable for photographs try a half size or a quarter size sheet and select the plate nearest to this size. The dimensions of plates do not run well with the sizes of paper in common use. Tracing cloth and roll paper can commonly be had 30 inches and 36 inches wide, and we have adopted 15x18 inch as a standard size, since either width can be cut without waste, but the nearest plate to our size is 14x17 inches. A printing frame was made to receive the 14x17 inch plate and rabbeted back to take 15x18 inch paper, thus allowing ½ inch margin on all sides. Now the cost of a first-class imported lens of this size will be about $100. It would be interesting, however, to examine the work of a more moderate priced lens of American manufacture and, if satisfactory, this item of expense might be considerably reduced. The camera itself will cost $50 to $60 and plates of the above size $9 per dozen. No gallery is needed the light from a good north window being sufficient, although a cross light from two corner windows, as shown in sketch, is preferred. It may be argued that since a "press the button" camera can be had for a few dollars that the above prices are extravagant; so they would be if they



POSITION OF CAMERA FOR COPYING DRAWINGS.

brought in no returns, but if it could be shown that an expenditure of $200 would save $500 in a year it would be admittedly economical, while an expense of $5, which brought in neither treasure nor pleasure, might be highly extravagant. "Process" plates are so easy to handle that a boy might work them who was not even a button pusher. The time required to follow a plate through all its various processes until ready to print is about one hour, but several negatives might be carried along at the same time, so that a man might finish probably twenty moderate sized negatives in a day. There are no secrets about the work, proper exposure and correct development will be the result of some experimenting. As all the contrast possible is desired between the lines and the background, care must be taken to stop the development before the lines cloud over, as in the finished negative they should be clear glass and the rest of the plate be most intense black. I have found a pencil mark on the copy to be an excellent guide in developing, since the pencil is gray and not black, as compared with drawing ink, and in developing it will cloud over long before the ink lines begin to turn. This, then, is the time to stop the development.

One advantage of the photo process is not only the ability to copy a drawing but the possibility of copying it either larger or smaller than the original, and the value of this feature is not in proportion to the ratio of enlargement; a slight increase in size being sometimes more desirable than a greater enlargement, as when copying shrunk plans to their original size. Oftentimes a pattern maker would like a drawing the exact size of the pattern. He can easily be accommodated by photographing the working drawing up to the size required, adding shrink for brass or iron as desired. In such cases the dimensions on the print refer of course to the corresponding shrink rule.

Owing to its ability to translate drawings from one scale of measurements to another the camera may prove a useful arbiter between the English and metric system, smoothing away some of the annoyances arising from the incomplete adoption of the latter. If the standard scale of the office were 1 inch to a foot, or 1-12 size, it would be a matter of some time and expense to redraw the plan to a scale of 1 decimeter to 1 meter or 1-10 size, to suit the requirements of foreign trade, but by the aid of the camera the plan may be drawn to such a scale as is most convenient, and copied to whatever scale is desired.

Many other uses for the camera will suggest themselves. A manufacturer may have patterns for a machine or a line of goods which he does not care to catalog in his regular list, yet which he would manufacture on orders. A supplementary catalog might be gotten up by means of the camera, containing views of the machine and its product, and such reproductions of the working drawings as might be necessary. A set of vigorous blue prints of about 5x8 inches with a 1½ inch white margin would make a creditable *brochure*, with no expense for engraving or printing.

W. H. SARGENT.

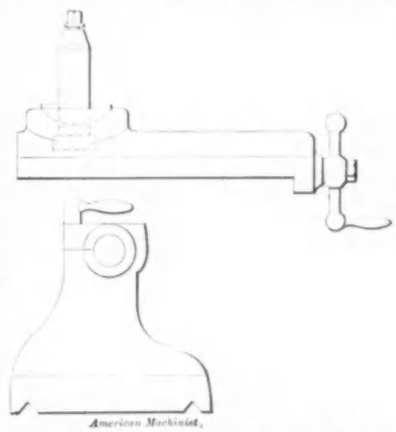
St. Johnsbury, Vt.

▲ ▲ ▲

Slide Rests—Countershafts Wrong Side Front.

Editor American Machinist:

In your last week's issue Mr. Sweet suggests an improvement on compound



rests. Allow me to call attention to another style, which, although very old, has many good points; with the foot

stock cut away as shown, we have a most convenient tool. The handle might also be made to be easily removed from rest, except that it sometimes gets lost.

We always enjoy looking at your advertising cuts, and your last week's (May 12) frontispiece seems unusually fine, but the man at the wheel evidently knows that the countershaft is not right side front, and is standing out of harm's way —perhaps brother Hartness may call this "obsolete." EDMUND STEVENSON.

Stamford, Conn.

▲ ▲ ▲

The American and English Slide Rests for Lathes.

Editor American Machinist:

I am not quite satisfied with the position Mr. Frederick Hart puts me in as regards the single and four bolt tool-post, for I do not believe the single bolt tool-post the best sort of devise for the purpose. But as our workmen continue to use it, from choice or necessity, and our builders continue to make them, all I aimed at in my design of compound rest was to fix the rest so it would be better for that kind of a post.

And further, when the four-bolt tool post or its equivalent is used on the American lathes, as it is getting to be on all large lathes, then I claim that for such lathes and the American workmen it would be better to have the square seat for the four bolts set at an angle with the slide, rather than as is the practice now.

The American workmen still have to set the upper slide parallel with the cross slide on account of the footstock.

With the English lathe and the English workman, the compound rest is right as they have it, but with our workmen and lathes it is not as good as the plan I propose, for in addition to the advantages mentioned in the original presentation there is this: the upper slide will, in the proposed form, serve to set for facing and cutting shoulders after the carriage is locked upon the bed.

The American lathe builders, in trying to meet the demands of the foreign customer for a compound rest and a footstock that will permit of its being turned parallel with the lathe shears, do not always comprehend the reason for the demand or succeed very well in the results. One builder I am told shipped lathes which, though the compound rest would swing around and clear all right, the handle of the screw would not clear at the bottom by half or three-quarters of an inch, and in nearly all cases of the single screw tool-post the slot is left just the same as in the original, thus defeating the very purpose the slot is for; that is, to be able to move the tool close to the face plate or close to the footstock.

Too much has been done without comprehending why the compound rest is demanded, and thinning down the parts of otherwise well designed simple lathes, and crowding in a compound rest of no particular sort is nothing but a makeshift.

This may be a severe criticism on lathe builders, but when they continue to put the handle on the little end of the eccentric shaft that throws the back gear out and in and provide only a temporary stop, and no lock to hold the shaft in place, is any criticism too severe?

JOHN E. SWEET.

Syracuse, N. Y.

▲ ▲ ▲

Some of the Old Methods of Originating Index Wheels.

Editor American Machinist:

I have read with very deep interest Mr. Randol's description of two schemes for originating a dividing wheel, and I give two more plans that have come indirectly to my knowledge. The first one that I will describe was used about the beginning of this century to make accurate and minute divisions of circles for astronomical and other instruments, and the other was used about the middle of the century or a little later to divide an index plate for a gear cutter. The idea has been in both cases to make the necessary number of divisions as accurately as possible in a circle as large as possible, or, at least, as large as convenient, and then to transfer these to a smaller circle, the motive for which can, of course, be easily seen. The first case was related to me by an old man, the later years of whose life overlapped the earlier years of mine, and who acted as helper on the job. His memory of the general scheme was clear enough, but he seemed rather hazy as to the details, which I will leave to be supplied by the imaginations of your readers rather than by my own.

In the center of a large sail loft was placed a heavy upright shaft, with its lower end in a step in the floor and with its upper end extending up through a tightly fitting box in the upper floor.

The index blank, or, perhaps, only a flange to hold a large disk of sheet brass, was driven on to the top of the shaft, and a heavy flange was keyed to the shaft near the lower floor. To this was bolted a wooden sweep as long as would swing around the room, with its outer end about touching the floor. Metal plates, probably copper sheathing, were nailed to the floor in a circle under the end of the sweep, and with a scratcher driven downward through the end of the sweep the circle to be divided was carefully swept on these plates. This circle was stepped off into any required number of divisions and marked with a center punch. The scratcher in this sweep would be used for a stop pin, and as it was moved from one mark to another it moved the plate on the top of the shaft the required distance for each division. My informant could remember distinctly that they put a large sheet brass disk on top of the iron plate or flange, and that they had some kind of arrangement for ruling the divisions into this brass disk, but he could not tell whether they drilled this iron flange to be used as an index plate or not. The plan would certainly be as available for drilling an index plate as for dividing a plate for optical or other purposes. It seems to me that this device, very carefully carried out, might produce an index plate that would be just about right.

A dozen or so years ago I knew an old man in the northern part of the State of New York named Brower, and about thirty years before that he had to make a gear cutter, one of the old style, in which the index plate was placed about the middle of a heavy upright shaft, a taper hole in the top of this shaft taking in a mandrel on which the gear blank was driven. For cutting spur gears this upright shaft was raised to carry the blank to the cutter by means of a pinion working in a rack cut into the shaft itself, each tooth extending clear around it, or, in other words, the teeth were cut on the shaft in a lathe, and the pinion was operated by a system of back gearing between it and a large pilot wheel. For cutting bevel, skew and screw gears the cutter was fed to the blank by one or other of two screws. An arrangement of lead pulleys allowed the cutter to be presented to the work in a great variety of positions. While this machine would not be called up-to-date to-day it was capable of doing a large variety of work of good quality, and it was stiff enough to stand hard pushing.

The most interesting thing about it, however, was not in sight, and that was the scheme adopted to divide the index plate, but Mr. Brower was kind enough to describe it to me. The plate was about 30 inches in diameter and the outer circle had 360 holes. The blank for this plate was put on near one end of a heavy shaft and on the other was a large wooden wheel made so that its diameter could be gradually reduced by turning it down as required, leaving it all the time with a fairly smooth, even face, and the shaft was placed between the centers of a large pit lathe. A long piece of band iron, I think about 30 feet long, had 360 holes bored through it as nearly equidistant from each other as possible. Each end of this piece of band iron was cut off at a distance from the end hole equal to half the space between the other holes, and the two ends were brought together and fastened in any way that would insure the two holes next the joint being the same distance apart as the rest. The wooden wheel was then turned down so that the band would drive onto it, fairly tight, and with the holes nicely in line as the wheel was made to revolve. When a stop pin had been fitted over the

holes in this band, and a drill had been placed to run through a well fitted and hardened steel guide at the face of the index blank, all was ready to drill the outer circle of holes. When this was done the band was taken off, cut open, shortened till it had the same number of holes as were wanted in the next circle on the index and closed up again. The wheel was then turned down and the band put on again and the work proceeded as before, and so on till the smallest circle was reached and finished. T. HODGSON.

Bedford, Que.

▲ ▲ ▲

An Improved Injector Nozzle.

Editor American Machinist:

The steam nozzles to the well-known "Monitor" injectors are screwed into the separating wall between the steam and combining chamber, so that comparatively a thin section is left for the seat of the valve, as shown in Fig. 1. The nozzle is shown at *A* and the seat for the controlling valve at *C*, while *B* is the separating partition. The thickness of this partition being only about 3/8 inch, it is worn away in a few years by the reaming and grinding necessary to keep the valve tight, and when this occurs the days of the injector's usefulness are ended, unless it can be repaired in some substantial manner.

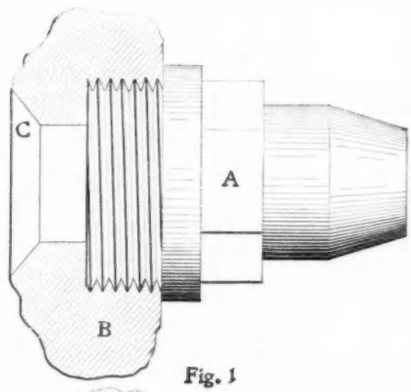


Fig. 1

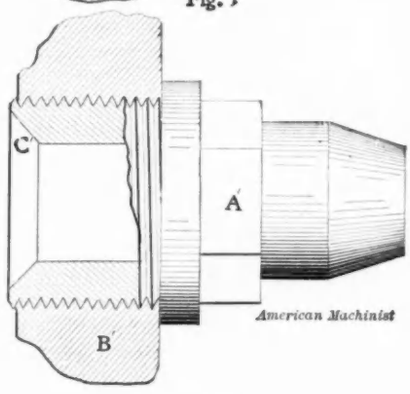


Fig. 2

AN IMPROVED INJECTOR NOZZLE.

On one railroad the seats were renewed by boring out a recess and forcing in a ring to form a new seat. This expedient, however, proved a failure, as the rings were rapidly loosened by the vibration incident to the action, and then the mechanic in charge of this work suggested that the scheme shown in Fig. 2 be tried. This has proved to be a success. As will be seen from the sketch, the thread in the separating wall is cut clear through, and nozzles are made with a long threaded part that extends through, so that a seat is formed directly on the end of the nozzle piece itself, as seen at C^1. No trouble is experienced with leakage past the threaded part, so that this seems to be a case where the repaired job is superior to the original, as it has the advantage of easy and quick renewal. Special taps have been made, so that it is not necessary to cut the thread through B^1 in a lathe, and as the cost of making A^1 is practically no more than of *A*, the repairing is cheaply done.

FRED E. ROGERS.

Corning, N. Y.

▲ ▲ ▲

The Centrifugal Pump.

Editor American Machinist:

The centrifugal pump, described in your issue of May 26, is a rebirth of an old idea in a modified form, which was originally described in either Parker's or Ganot's Physics or text book, used in the schools in the early sixties.

The original pump was intended only for suction and the discharge pipes were slightly curved on a tangent to their circle of rotation—not upward and inward, as your correspondent's sketch shows. The pump should start (unless the hight of suction is great) without the riser pipe being filled, as the centrifugal force would overcome gravity.

The addition of an air chamber, with stuffing-box, is seemingly good, and converts it into a force pump, which should have a high efficiency. The upward and inward curving of the discharge pipe is of doubtful utility. J. B. HALL.

Auburn, N. Y.

▲ ▲ ▲

Screw Machine Tools.

Editor American Machinist:

The article on "Screw Lathe Tools and Work," in issue of April 14, makes me think that perhaps the way we make some of our tools will prove of interest. At one shop where I worked we made forming tools the same as those described, except that our tool block was a little different. But in cutting the form into a flat surface, as those are, necessitates a clearance, to prevent their rubbing and tearing, and there is where the trouble comes in. Some of the shapes had narrow slots, about 1-16 inch or so wide and from 1/8 to 1/4 inch deep, and when it came to clearing the sides of those slots we used to think things unutterable. The shaper tools were necessarily so slender that they would spring easily, and then when they did take hold they did so with a vengeance, and at the expense of making another tool.

Very truly this style of forming tool is rigid, but if instead of clamping a circular tool to a bar in the tool post we

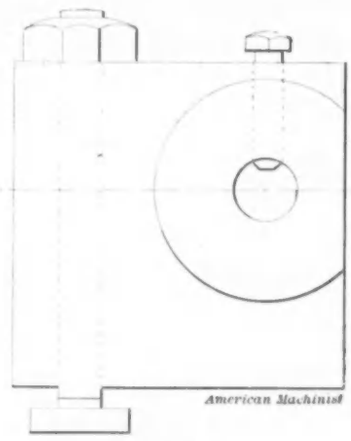


Fig. 1

make a special block, as Fig. 1, we have something just as rigid and easier made, besides being longer lived. The tool block is about 4½ inches square by 2 inches thick, and has a ¾-inch hole through it counterbored about 7/8 inch deep and 2⅞ inches in diameter. The tools are made of 3-inch steel, cut off to suit the length of work wanted and drilled out ¾ inch. They are then turned

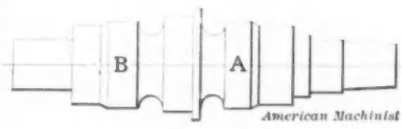


Fig. 2

on a mandrel and the form turned into them. We cut them in such a way as to run the machines forward, thereby drilling and forming at the same time. The set screw shown at the hole for the bolt comes down on to a flat on the bolt to

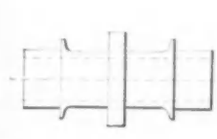


Fig. 3

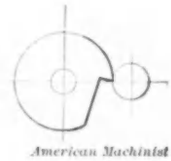


Fig. 4

prevent it from turning while clamping the tool into place.

The bolt head is made large and about ¼ inch thick, so as to allow setting the cut close to the chuck.

Fig. 2 shows a piece of work 5⅜ inches long and made from 1 9-16 inches stock

that gives some idea of how well these tools hold to place. We use a front and a back tool and make two cuts. The end *A* is cut first, and then the stock is moved out and a revolving support in the turret steadies the end while the back tool cuts the end *B*. A cut-off is swiveled on the bolt head of the front tool, so that it can be dropped into place to cut off the piece when done.

Fig. 3 shows another piece, which we make on an "automatic," and drill and form simultaneously, and the automatic tool blocks are not nearly so heavy as the one shown, space on the machine preventing the use of that kind; so we made an angle plate and recessed it for the tools. The piece is 2¾ inches long and made from 1⅜ inches stock and drilled ⅝ inch. The ends are ⅞ inch diameter. This piece is formed by one tool.

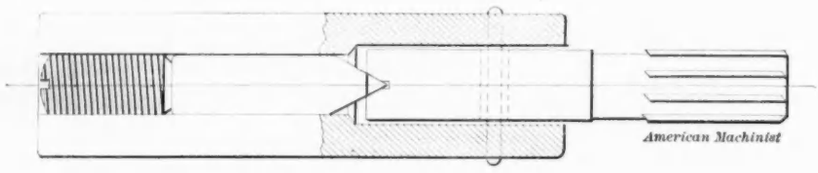


Fig. 5

We use these tools on the automatics on tool steel also. Fig. 4 shows how we set the tools and also how we cut them, but it must be remembered that a variation of the angle of the cutting edge varies the relation of the largest diameter of the work and the smallest diameter, *i. e.*, the more hook to the tool the larger will be the largest diameter in relation to the smallest, so the tool will have to be turned to suit the angle we wish to use. But I sometimes use this property to correct slight errors of the tool.

Fig. 5 shows a good holder for taps or reamers, which allows them to find their own center, thereby cutting smoother and nearer to size, as when they are held rigid they cut larger, unless everything centers up nicely. The screw in the back end holds the center to place and allows an adjustment of the center to suit the hole through the shank of the tool. This hole is made larger than the pin to prevent a bind, and the shank is a shaky fit for the holder also. The pin is tight in the holder.

The center in the tool shank should be large.

A. D. McElhose.

▲ ▲ ▲

Heating Feed Water by Live Steam.

Editor American Machinist:

In your issue of May 26 you have an article on "Heating Feed Water by Live Steam," but you don't say how it is done. On the Ohio River I have put into steamboat boilers (most generally two-flued ones) what is called a Snowden heater, consisting of two or three lengths of pipe running from one end to the other and return, in the upper part of the boiler or the steam room, and then discharging down into the mud drum, which catches the mud and obviates its precipitation on the heating surfaces. This is heating water by live steam, and the heater is where there can be no loss by radiation. Besides this heating, the water is first heated by exhaust steam, then taken by the pump and forced into the top of the boiler, then through the Snowden heater. There can be no doubt that this system is better than heating cold water by live steam only. The Hoppes system of heating first in an exhaust heater, then in a live steam heater and lime extractor, is also better than the Kirkaldy system, if I have construed your article aright. As I said before, your article is not to the point. Your saying a thing is done and not telling us how it is done makes it as clear as mud.

Using an injector instead of a pump is always, or rather most generally, considered a waste of steam. I have taken out an injector when it had been found necessary to stop the engine while the injector was at work because the boiler would not make steam enough to run them both at once, and afterward I put in a belted pump and had no more trouble. I find that a belt driven pump costs much less to run than a steam pump, because the steam cylinder condenses so much steam, which is a great loss, but the worst evil of the steam pump is that they are run as long as they will run, although they lose ten times as much steam as is needed if they do not leak, because the leaks are invisible except at the end of the exhaust pipe when the leak is in the steam end, and always invisible when in the water end.

Harry Gunther.

San Antonio, Tex.

[The information given by us in the article referred to was credited to the "Engineer," London, and gave practically all the information which appeared on the subject. The heater using the live steam was such as might also have been used with exhaust steam. As we intimated, the use of the exhaust as far as available first must be a saving of heat whether the live steam is employed thereafter or not. Our correspondent's statement of his experience with the Snowden heater seems to be a confirmation of the statement as to the economy of using live steam for heating feed water.—Ed.]

School Draftsmen.

Editor American Machinist:

I have read with great interest your editorial in the issue of May 6 on "School Draftsmen." As to your statement of fact, there is no exception to be taken to it. School draftsmen are not generally worth the powder to kill them when first "turned loose" by the schools, unless they have had some drill in a commercial establishment in addition.

But to your thesis, that it ought to be a simple and easy matter to turn out draftsmen from the school without the commercial drill, I think some exception should be taken.

The trouble is, I think, not that the school draftsman cannot make a good drawing of any given object, but that he cannot make one that is any good to work by in the shop, for two reasons: he cannot make it half quick enough, because he doesn't realize the importance of doing so, and wastes too much time on "frills," and he cannot put the dimensions on it to supply the information that the workman wants, in the way he wants it, and this last is the really important point. He cannot do this, because he does not know, in all probability, how the piece is to be made and what the important points about it are. To take a familiar case, he does not know whether the hole ought to be in the center of a given boss, whether the boss is in the correct place or has been moved by a variation in shrinkage, or whether the hole ought to be at a definite distance from some other point or surface, whether it hits the center of the boss or not. This is only one of scores of similar points, and the only way to settle them is by asking the boss or knowing the natural history of the piece.

It will hardly be denied that no man can be a commercially successful designer unless he knows how every piece is to be made, preferably from the pattern-maker, certainly from the molder to the erecter, and it is hardly less true that a draftsman, to be a really good one, should have the same knowledge. And this is not the same as the dim and vague collegiate knowledge that this can be done (perhaps with infinite expenditure of time and trouble) thus and so; but the commercial knowledge that it can be done best and cheapest, thus or so.

If this proposition be granted then its obvious corollary is that a man to be a good draftsman must be a pretty good mechanic, and to be a good designer he must be a first-class one, at least in his knowledge of shop processes and economical methods.

This kind of man none of the schools have ever turned out, although some come nearer it than others. Whether they could do so or not, I do not pre-

tend to say, or whether it would be worth while, considering what it would cost.

But what I do know, or at least feel reasonably sure of, is that a great deal more attention could be paid to the commercial side of all these things than there now is at the schools, and the idea that the almighty dollar is the foundation of all engineering work, and that ability as an engineer is not measured in brains but dollars could be pounded into the students, at least to such an extent that they would not be shocked to be told that a man built high grade engines and quit building low grade ones because he thought there was more money in it, and not from high moral grounds. That one was shocked in this very way a number of years ago I know very well, and I think the attitude of mind revealed thereby is not uncommon. Along with this line of teaching it should be drilled into the students in all exercise work, whether drafting, shop work or figuring, that to get a thing done quickly is just as important as to get it done right; also that the time cost of frills in any of these things is apt to be many times their value (when they have any at all.)

Far be it from me to decry care or thoroughness. They are absolutely essential, but schools being places in which primarily principles are taught (and this was formerly the case more than it is now), the idea almost inevitably grows up that if the student understands the matter in hand it is enough, but this is not so; the gap there is between knowing how to do a thing, and doing it, amounts in many cases to a chasm, into which I presume we have all take an occasional "header" in our time.

Even in the matter of calculations, in which one would think the student, being in practice and familiar with a subject by present or recent study, would be able to do more than after being out a few years, this same thing holds true. The student understands the principles thoroughly, yet set him at a concrete case and he has pretty nearly to learn the subject all over again in order to apply it, and would be aghast if given as an exercise in figuring a piece of work which ten years later he would hail with pleasure, almost as a recreation. This would necessarily be so in any event, to a certain extent, but it might be so much less than it is if the students were habitually made to do things in the way of exercises that would more resemble those they will have to do in after life.

Here again I wish to state that I am not decrying principles. They are the most important things that the ablest students learn, but principles alone will make a hard row to hoe for their possessors for several years. They must be backed up by practice.

It may be objected that there is not time for all of this in a college or a university without cutting something else out, but I do not admit this; I doubt if any student works much over eight hours a day on an average, excluding Saturday and Sunday, while when he gets to work in earnest he will have to work at least nine and probably ten, and will have two weeks' vacation instead of six or eight. If he did a little more in college, going to work in earnest would not come on him as such a shock to his nervous system.

To return more particularly to the question of drafting, there can be no question that some valuable time is wasted over "shades, shadows and perspective." These are seldom or never of use to an engineer, and ought not to be bothered with. Descriptive geometry proper is more important than people often think, for it frequently does not get credit for what it does. A man strikes a complicated problem in drawing or designing, gets an idea of it in one plane and twists it around through his gray matter until he sees, little at a time, how to get the other views or whatever information he desires. If you ask him how he did it he will tell you "horse sense," when all the while the methods were those of descriptive geometry which he had "evolved out of his inner consciousness," as the German did the picture of the camel. It is probable, however, that there is room to simplify this study also, and bring it into closer touch with practical problems.

In the direction of utilizing present facilities to give the students a clearer idea of the information which ought to be on a drawing, it seems as though some good would be done, in those cases where the students design and build some piece of machinery, to let each one work after the drawings made by another rather than himself, preferably on some part with the drawing of which he was least familiar, and forbid the use of scaling to determine dimensions in the shop. In that way each would have his mistakes and omissions brought unavoidably to his notice, and would see in practice a good many of the best ways not to do it, as practiced both by himself and the others.

As to the drawing being only a means to an end—no one I suppose will question the importance of having it hammered into the students thoroughly—it is surprising to see the completeness with which this idea is *not* grasped in general, until the commercial "drill" has made an entry for it.

To carry this matter to its legitimate conclusion why not have the time of draftsmen kept on all their work and be able to show the laggards, if need be, what their work cost with relation to that of others? It would perhaps occasion some ill-feeling at first, but none for which any good ground could be given.

I hope that this may serve to bring out a reply from someone with something better to say and better able to say it; if so, it will have done as much as I can expect.

J. E. Johnson, Jr.

Longdale, Va.

[We think our correspondent entirely underestimates the amount of work exacted of students in technical colleges. We very much doubt if the average hard student ever puts in as many hours per day when earning a living as he did when a student. The amount of work required to-day is, in fact, so great, that but for its diversified character it could not be long endured.—Ed.]

▲ ▲ ▲

Power Per Pound.

The "Mechanical Engineer," London, gives the following table of the approximate heat values per pound of various fuels, and the approximate energy which each would produce, with also the efficiencies theoretically to be developed per pound of electric storage battery, of hot water and of liquid air respectively:

Material.	Heat Energy Per Pound, B. T. U.	Foot-Pound Per Pound of Material.
Natural gas	24,000	*2,800,800
Illuminating gas	22,600	*2,637,300
Petroleum	20,000	*2,334,000
Water gas	7,061	*823,900
Producer gas (bit.)	2,380	*277,600
Producer gas (anth.)	2,100	*244,950
Anthracite coal	12,500	†972,500
Bituminous coal	8,200 to 14,500	622,400 to †1,128,106
Storage battery	.....	8,500 to 15,000
Water, 400 pound pressure, and 445° Fahr.	.....	§43,000
Liquid air	.....	139,900

▲ ▲ ▲

A Proposed Boycott of American Machinery.

The French paper called the "Journal des Transports" calls attention to the reported boycott by American women placed upon French milliners, etc., and advises French railroads and "tram lines" to refrain from buying American machine tools and machinery and Westinghouse brakes. We feel free to say that if French users of machinery fail to give themselves the advantage of using American machines and "slacken their orders and finally suppress them altogether," as they are advised to do by our French contemporary, they will probably do themselves far more injury than they will do anyone else, and it is probable that there is nothing that German and other European manufacturers would be more glad to see than such a systematic attempt on the part of the French manufacturers to hold themselves aloof from progressive influences.

* If used in a gas engine of 15 per cent. efficiency.

† If used in a steam engine of 10 per cent. efficiency.

§ If 20 per cent. of its heat is transformed to power.

AMERICAN MACHINIST

Published Thursdays by

American Machinist Publishing Co.,

256 Broadway, New York.
JOHN A. HILL, President and Treasurer.
C. A. HANSMANN, Sec'y.

Editorial Department.
FRED J. MILLER, Chief.
FRANK RICHARDS, F. A. HALSEY, EDWARD P. BUFFET, } Associate Editors.

Illustration Department.
A. L. DONNELL, Chief.

Advertising Department.
C. P. DAY, Eastern Representative.
J. M. WAKEMAN, Western Representative.

Foreign Agents:
R. E. HOWARD,
10 Finsbury Square, London, E. C.,
Representative for Great Britain.

FENWICK FRERES & Co.,
21 Rue Martel, Paris,
Representative for France, Belgium, Switzerland and Italy.

WEEKS & JOHNSON,
Lovedoy St., Johannesburg,
Transvaal Republic,
Representative for South Africa.

Space in advertising pages only is for sale.
We invite correspondence on subjects pertaining to machinery.
Name and address must always be given, though not necessarily published.
Communications for or relating to the reading columns should be addressed to the Editor. All business communications should be addressed to the Company.
Subscribers can have their mailing address changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrappers denotes week with which subscription expires.

Subscription Price:

$3.00 a year in advance, postage prepaid in the United States, Canada and Mexico.

$4.00 a year to other countries, postage prepaid.
Entered at Post Office, New York, as second-class mail matter.

For Sale by Newsdealers, Everywhere.
No back numbers beyond 1897.

▲ ▲ ▲

Cycle Manufacturers Want Reduced Tariff.

Our readers will remember that in our issue of January 20 we called attention to the indisputable fact that under the present conditions actually existing the only real effect of some of our tariff schedules is to give foreign machinery builders a powerful argument to present to their respective governments for an increase of duties intended to shut out importations of American machinery.

At the time of the writer's visit to Germany last year German tool builders were actually using our tariff as an argument in favor of higher German tariffs on importations of American machine tools, and anyone who will for a moment put himself in the place of these German tool builders will admit that their argument is not without force, at least when viewed superficially.

We understand that some American bicycle manufacturers have been led to see the truth regarding this matter and that a movement is under way among them to ask for a reduction of our present ad valorem duty of 40 per cent. to a small duty per pound which will be merely nominal. The argument they present in favor of such a reduction is that the present duty affords no revenue, and probably no duty on wheels would do so because none are liable to be imported. Large numbers of American wheels are sold abroad, and our present high tariff duty imposed upon foreign wheels has really only one effect, *i. e.*, to place in the hands of foreign bicycle builders a strong argument in favor of high and higher tariffs on American wheels in foreign countries. In other words, these American cycle builders state that the only effect of our tariff on wheels is to injure our foreign trade in cycles and to help those who threaten it with still greater injury.

In the article above referred to we tried to set forth the importance of looking facts squarely in the face in connection with such matters, and it is becoming every day more plainly apparent that our foreign business in manufactured goods will be seriously handicapped unless we do this and stand ready to promptly discard or modify things that we have outgrown and which are useless or worse. We are averse to saying "we told you so," but this action of cycle manufacturers shows that the "logic of events" points in the direction indicated by us last January, and in view of the fact that American manufacturers are generally controlled by reasonable motives and are not much inclined to pursue a course plainly opposed to their own interests some further progress in the line we have indicated may be confidently looked for.

▲ ▲ ▲

The Metric System.

By the courtesy of Mr. H. M. Lane, of Cincinnati, we have received in pamphlet form a copy of an address delivered by him May 9 before the Manufacturers' Club of Cincinnati, entitled "The Metric System of Weights and Measures." In this address Mr. Lane takes the ground of opposition to the employment of the metric system, but we do not see that he has brought against it any new objections or, in fact, any objections which, to our mind, have not been adequately answered so far as the relative merits of the two systems are concerned, irrespective of the expediency of making a change from one to the other at this time. This may be an appropriate occasion to state that we have, during the past few years, had many opportunities to publish articles, pro and con, regarding the relative merits of our present system of weights and measures as compared with the metric, but it seems to us that practically it is not now a question of which system is the best. It is our belief that if we were not doing any measuring or weighing and our present system and the metric system were both at the same time presented to us with a free choice of adopting the one best adapted to practical use there would then be no doubt of the adoption of the metric system. Such, however, is by no means the condition, and the main question is as to the amount of labor and expense involved in changing from the one to the other system. We do not believe that it would be practicable to change over bodily from one system to the other, but we do believe that the use of the metric system is extending slowly in this country, and that it will continue to extend by reason of the fact that we are doing and probably will continue to do an increased amount of business in countries where the metric system is exclusively used. We believe that each step taken toward the general use of the metric system will be taken because at the time it is commercially advantageous to the man who takes it, which man will not concern himself as to which is the best system. That is to say, if a man has an order for a machine to go to a foreign country and the specifications require that it be built to the metric system, in whole or in part, and the price which he can get for the machine will justify him in going to the necessary expense and he can see a profit in the order, he will accept it, and to that extent will adopt the metric system. This has been done in a number of cases, both here and in England, with, so far as we know, entirely satisfactory results, and we believe it will go on just as far as and no further than it is commercially advantageous to do so, and that discussions as to which system is intrinsically the better will affect results very little, it at all.

A committee of the American Railway Association addressed a communication to Mr. L. Weissenbruch, secretary-general of the International Railway Congress and chief engineer of the Belgian State Railways, regarding the use of the metric system in railway work. In his reply Mr. Weissenbruch, after describing some of their customs and methods, refers to the paper of Capt. Sankey, of the Willans & Robinson Company, from which we have quoted, and says that this favorable record of actual experience is better than all theoretical discussions of the matter and closes as follows:

"As secretary-general of the Railway Congress and from scientific interests, I am happy to understand that the metric system has some chance of being adopted in the United States; but as a citizen of Belgium I may perhaps regret it, because it would greatly aid the Americans to compete with Belgian industries in countries to which they export."

Use of Authorities by Expert Witnesses.

The extent to which an expert witness may make use while on the stand of recognized authorities has been a matter of doubt, and it has been held that the authors of such books not being under oath their statements or opinions could not be admitted as evidence. In a recent case before the United States Circuit Court for the Southern District of New York Judge Lacombe ruled as follows: "We feel no hesitancy in so modifying the general rule as to hold that, where the scientific work containing them is concededly recognized as a standard authority by the profession, statistics of mechanical experiments and tabulations of the results thereof may be read in evidence by an expert witness in support of his professional opinion, when such statistics and tabulations are generally relied upon by experts in the particular field of the mechanic arts with which such statistics and tabulations are concerned."

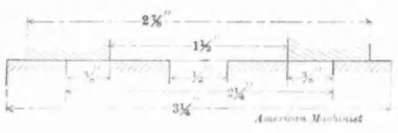
▲ ▲ ▲

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(65) E. E. L., Cropsey, Ill., says: It is sometimes asserted that a projectile from a gun rises from the muzzle even when the gun is fired on a level line, and I therefore ask does a 13-inch projectile fired from a cannon aimed on a dead level rise from the level or does it begin to fall immediately on leaving the muzzle of the gun? If it does rise, please state why. A.—We do not think that a projectile rises at all under the conditions mentioned. Certainly it cannot rise except some force acts upon it to produce that effect, and after leaving the muzzle there are only two forces acting upon the projectile, the attraction of gravitation and the resistance of the atmosphere, and we think a projectile begins to descend at the moment of discharge.

(66) G. N. B., Burlington, Ia., desires to know the proper dimensions of the ports, pipes and slide valve for a 6x6 engine driven by compressed air and operating a crane. The speed is to be 150 revolutions per minute, and the valve travel intended is 1½ inches. A.—Your travel is excessive. The piston speed is



low, and the ports and valve required are correspondingly small. Of course, the travel proposed can be used, but we should reduce it to 1⅛ inches, and make the ports 3 inches long by ⅜ of an inch wide, the other dimensions of the valve and seat being as in the accompanying sketch. The supply pipe should be 1¼ inches and the exhaust 1½ inches.

(67) F. W. A., Philadelphia, asks: 1. What is the simplest rule for calculating the power transmitted by belts, either single or double? A.—Multiply the width of the belt in inches by the number of feet of belt travel per minute, and divide by 600 for single belt and by 400 for double belt, the result will give approximately the horse-power which may be safely transmitted. Thus a single belt 4 inches wide, running 900 feet per minute, will transmit $4 \times 900 \div 600 = 6$ horse-power. A double belt, 12 inches wide, running 1,000 feet per minute, will transmit $12 \times 1000 \div 400 = 30$ horse-power. 2. What percentage should be allowed for friction of line shafting? A.—The friction of line shafting varies so widely and the conditions involved are so various that it is impossible to give any rule that would be of any practical value. It would not be difficult to find shafting in which the loss by friction is less than 10 per cent., while other melancholy instances are on record where the loss has been as great as 90 per cent.

(68) D. G. M., St. Marys, Canada, asks: 1. How am I to determine what size to make a driving pulley? For instance: I have a line shaft *A* running *a* revolutions, and want to drive shaft *B* at *b* revolutions; supposing there is nothing in the way to hinder, what determines the size of the pulley on *A*? A.—It is always necessary to assume the size of one pulley, and then the diameter of the other will be inversely as the required speed of its shaft to that of the first shaft. The principal consideration determining the size will usually be the amount of power to be transmitted. If the power to be transmitted is large then both the diameter and width of the pulley should be larger than if the power is small. If one shaft is to run at double the speed of the other then its pulley will be only one-half the diameter, but in one case both pulleys would be larger than in the other case. Allowing 50 square feet of belt travel per minute if single, or, say, 35 square feet if double, will give a good basis from which to start in determining the size of the pulleys. Say that a shaft running 150 revolutions per minute requires a pulley to transmit 3 horse-power to another shaft. This will require $50 \times 3 = 150$ square feet per minute. If we take a 3-inch belt, then the travel of the belt must be $150 \times 4 = 600$ feet per minute. As the shaft makes 150 revolutions per minute then $600 \div 150 = 4$ feet of belt travel per revolution, or 4 feet will be the circumference of the pulley. If we call the circumference three times the diameter, which is near enough for this case, the diameter of the pulley will be 48 inches $\div 3 = 16$ inches. The diameter of the pulley on the other shaft will then be determined in the usual way, and it will be to the diameter of this pulley inversely as its speed is relative to that of the first shaft. If this shaft is to run double as fast as the first shaft it will require a pulley 8 inches in diameter, and in that case it might be thought best to use pulleys of larger diameter and a narrower belt. Thus 24-inch and 12-inch pulleys with a 2-inch belt would give practically the same result and would usually be preferable. 2. In the case of gears, if two spur gears of equal diameter run together on shafts *A* and *B*, and if two smaller gears were put on in place of them with an intermediate gear to connect, would there be any difference in the amount of power transmitted? A.—There would be no difference except that in the latter case there would be a slightly increased loss by friction. 3. If in transmitting power from *A* to *B* we are not tied as to distance between centres, what determines the size of the driving wheel if one wheel is larger than the other? A.—The pitch diameters, or rather the numbers of the teeth of the two gears, will be inversely as the numbers of revolutions. The actual sizes of the gears will be determined, as in the case of pulleys, by the amount of power to be transmitted.

▲ ▲ ▲

Technical Publications.

EVERYONE'S GUIDE TO PHOTOGRAPHY. By E. J. Wall. 246 4x5¼ inch pages with 28 illustrations. Spon & Chamberlain. Price, in cloth, 50 cents; in leather, 75 cents.

This is one of the numerous books which have appeared on photography since that art became an amateur craze. It is well adapted to this class of seekers after knowledge, although it is in some respects of too advanced a character for such readers, and calls for apparatus of a more expensive construction than the average amateur possesses.

GAS, GASOLINE AND OIL VAPOR ENGINES FOR STATIONARY, MARINE AND VEHICLE MOTIVE POWER. By Gardner D. Hiscox. Second Edition, Revised and Enlarged. New York, Norman W. Henly & Co. 365 pages.—6x9 inches. 270 Illustrations. $2.50.

That a second edition of this book, which we noticed in its first edition last year, is so soon called for speaks for itself as to how well an actual want has been met by it. A mass of information relating to the various so-called explosion engines is here collected and put in shape to be easily referred to. The book is enlarged by the addition of nearly a hundred pages, the additions consisting largely of new makes of engines. The list of patents relating to these engines is brought up to date, and a list is also given of makers of such engines in the United States. In connection with the list of patents the reader is told where they may be had for 10 cents per copy, but he is not told that they may be obtained from the Patent Office for 5 cents.

▲ ▲ ▲

The "Engineering News" devotes a good deal of space to replying to the criticisms of "The Engineer" on our conduct of the war. It is useless. "The Engineer" does not, in our opinion, intend to be fair in its treatment of American subjects any more than the "Saturday Review" does, and the only thing to do with either of them is to let them keep on vilifying us to suit their own ideas of what their readers want. There is no use arguing with a journal which assumes that our blockade extends entirely around the Cuban coast, in order to enable itself to declare that blockade to be ineffective, because Cervera entered Santiago harbor. The reply of the "Engineering News" is complete and satisfactory for anyone who wants to get at the facts, but for those who do not care for the facts it is useless.

Affiliation of the Niles and Pond Works--A German Niles Works.

The interest of the late Eugene Maxwell and that of his brother (who is president of the Central R. R. of N. J.) in the Pond Machine Tool Works, of Plainfield, N. J., together with some other stock, perhaps, have been purchased by men interested in the Niles Tool Works Company, of Hamilton, Ohio,

It is not the intention to consolidate the two companies—in fact, it is the intention to preserve the entity of both of them, but sufficient of the stock of both companies is now held by the same men to enable some of the more objectionable features of the heavy machine tool business which have prevailed in the past to be eliminated. Mr. T. T. Gaff, who is a relative of the Mr. Gaff who was at one time associated with Alex. Gordon, at Hamilton, is now president of the Pond company, and C. A. Moore and Henry S. Manning, of Manning, Maxwell & Moore, are vice-president and treasurer respectively.

Although at this writing much remains unsettled, it is expected that both works will run along about as they have been doing, but that there will be some cooperation and some arrangement by which shipping and other expenses will be reduced. Mr. Stebbins is expected to continue as superintendent of the Pond shops.

Heavy tool builders have had a hard struggle during the past few years, some of them having paid no dividends for several years past, and in fact actually falling behind somewhat. This change will of course by no means monopolize heavy tool building, because if for no other reason there are still large interests outside of the newly affili ted companies. It is expected, however, that this move will lead to some much needed improvement in the tone of the market.

Another move of importance to the machine tool interests is the establishment of what will be known as the Deutsche Niles Werk-zeug-Maschinen-Fabrik, at Berlin. This will be really a German Niles works, and Mr. Alex. Gordon, president of the Niles Tool Works, at Hamilton, who has engineered the matter in Berlin, speaks quite enthusiastically regarding the new company. It will start with a capital investment of 8,000,000 marks (about $2,000,000) and Mr. Gordon declares will erect in Berlin the finest machine shops in existence. The ground for these has been secured at a cost of about $200,000 near the works of the Allgemeine Electricitäts Gesselschäfts (the General Electric Company), which concern has a magnificent shop building near the river Spree. This company or men connected with it own stock in the new Niles Works Company, as do also Ldw. Loewe & Co., the Berliner Bank, the well-known Vulcan Works, of Stettin, shipbuilders; the Deutche Bank, A. Borsig, locomotive builder, of Berlin, and other important manufacturers, most of whom are large users of machine tools and in fact have made large purchases of Niles tools made at Hamilton.

Mr. Gordon states that these tools were so well liked by these German users that when someone proposed the organization of a German Niles Tool Works they were very ready to subscribe for the stock. The majority of the stock is held in Germany and the equipment for the shops will go from America, mostly from Hamilton. The works will have a capacity for the employment of about 1,500 men and will be about the same size as the works at Hamilton. Mr. Gordon sailed for Europe last Tuesday, to be gone until October.

▲ ▲ ▲

The French Import Duty on American Machinery.

In reference to the matter of a reciprocal arrangement with France more favorable to our exports of machinery to that country, we have before us a letter from the Hon. John A. Kasson, Special Commissioner Plenipotentiary, in which he says:

"The importance of machinery as a leading export of the United States is fully appreciated, and had it been possible to include it in the late negotiations it would have been done.

"The late convention with France, under Section 3 of the tariff act, could only comprise very few articles. We have indicated to France our willingness to negotiate under the fourth section of the tariff act, which embraces the whole range of exports. The French have as yet shown no disposition in favor of it.

"France grants her minimum tariff only to nations which secure it by treaty. England has such a treaty, while we have not."

▲ ▲ ▲

Trade with China.

The Secretary of State has transmitted to Congress, through the Secretary of the Treasury, a letter asking for an appropriation of $20,000 for the purpose of sending a commission to China to study the commercial conditions of that country as they affect those of our own land.

China has a population of 400,000,000 and its foreign commerce amounts to about $200,000,000 annually. Of this Great Britain obtained about two-thirds, Japan one-eleventh and the United States one-twelfth in 1896. Our manufactured goods are already very popular in China, and it will soon become a vast field for enterprise. A New York Chamber of Commerce report already calls attention to an increase in our export trade to China from $8,117,059 in 1893 to $17,978,065 in 1897; and this only includes merchandise directly transported to that country.

Great Britain, Germany and France have already sent similar commissions, and there is every reason to hope that Congress will make the necessary appropriation in the present case. A. F. T.

▲ ▲ ▲

Passed Assistant Engineer Beach, of the Baltimore, in writing of his share in the Manila Bay fight, says: "My personal part in the fight was in the engine room. The hard part of this engagement was not the fighting part; that was all right, but it was in getting ready for it. I was thirty-two hours without relief or rest in the engine rooms, the temperature varying from 120 to 160 degrees." This is the kind of heroism that is in operation every day on most of our ships, but little is said of it in the secular press. The story of the wonderful run of the Oregon is chiefly that of the devotion to duty and the unflagging endurance of the men at the machinery, but Captain Clarke is the only one whose name is mentioned in connection with the feat.

▲ ▲ ▲

An order has been placed by the Boston Elevated Railroad Company with the Walker Company, Cleveland, for what is said to be the largest direct current generator ever built. This generator will have a rated capacity of 4,000 horse power, and will be capable of delivering over 5,000 horse power for a few hours at a time. It will weigh over 300,000 pounds. The outside diameter of the field magnet will be about 24 feet. The field will contain twenty-four or twenty-six magnet poles.

▲ ▲ ▲

The bill providing for the classification of patents, which we referred to a short time ago, has become a law, and under its operation it is expected that examinations will be facilitated and better work done in the Patent Office.

▲ ▲ ▲

It is announced that a Pullman works is to be established in Russia, and that cars will be built there under very favorable conditions granted by the Russian Government.

▲ ▲ ▲

Personal.

Mr. Arthur Keen, vice-president of the Institute of Mechanical Engineers and a member of the firm of Bolckow, Vaughan & Co., Ltd., Middlesbrough-on-Tees, England, is visiting this country.

Richard Thirsk, for the past three years superintendent and designer for the National Elevator & Machine Company, has accepted the position of master mechanic

of the Indian Head Cotton Mills, Cordova, Ala.

Mr. Lucian Sharpe, of the Brown & Sharpe Manufacturing Company, Providence, who has been ill for some time, sailed June 7 on the Kaiser Wilhelm der Grosse, and will spend three or four months in Germany seeking rest and recuperation.

▲ ▲ ▲

Commercial Review.

NEW YORK, Saturday Evening, June 18, 1898.

In another column will be found an important item of trade news—the measures which have been taken to bring into a closer business relation the Niles and Pond machine tool interests.

MACHINISTS SUPPLIES.

It is almost, if not quite, time that trade should show a seasonable easiness. What with the war and the approach of midsummer buyers are already manifesting a disposition to keep around the corner.

Supplies are still being purchased quite freely from local sellers for Governmental purposes, as investigation among them shows. One of them spoke of having received several such requisitions the day we saw him, and another said he was receiving them every day. Files, emery wheels, twist drills, etc., and for camp purposes vises and forges, are examples of the goods that have been called for. Some $5,000 worth of twist drills are said to have been purchased for the Brooklyn Navy Yard at various times within about ninety days past, which ought to be enough for the present.

It is stated that preparations are being made to advance prices in certain lines. Two of these, in which the changes have begun to take definite shape, are wrenches and pipe taps, although in the former, at least, the advance has not yet become universal. On the latter the shrinkage in the discounts will be about 20 to 25 per cent., and is due to an "understanding" among manufacturers, though how far it will be made effectual to the consumer is a question.

A seller of emery wheels remarked as follows: "May and October are usually our best months. The past May and the first of this month were quiet. Since then there has been some improvement in our own case, owing to orders from large dealers rather than from consumers. The small machine shops in Brooklyn and Jersey City are depressed."

In a subsequent conversation with another seller of emery wheels he observed that he thought that some demand was coming from the smaller shops, because so many large ones are filled with Government work, which was turning regular trade into the obscurer channels. He would not deny, however, that they were dull in this vicinity.

Mr. L. Best, agent for the Sterling Emery Wheel Manufacturing Company, has taken the whole store at 45 Vesey street, New York, and has put in a stock of unusual size. It includes 25,000 wheels of 1,800 varieties. Mr. B. B. Esby, vice-president of the Sterling Company, sailed this week for Europe, where he will pass through about every country, except Russia. It is stated, also, that he will not visit Spain.

The Law Company has moved from 123 Liberty street, New York, and opened a store for emery wheels at 109 Walker street.

Among late export sales of machinists' supplies reported are some 160 dozen twist drills sold for the Australian market and nearly 100 emery wheels of 24 inches diameter and under for the North of Europe.

As an indication of confidence in future business conditions it is encouraging to learn that the Arcade File Works, Anderson, Ind., intend to proceed to the erection of their new plant after the July 1 inventory. This plant, it may be remembered, has been proposed for some time. It has been somewhat retarded by the war. If the plans be carried out as originally stated they will bring the capacity of the works up to to an output of 5,000 dozen files per day.

Power transmitting machinery continues to be a subject for good reports in spite of the war. A large supply dealer informs us that the makers of goods of this class are constantly putting off his orders while they fill others of a pressing nature. Regarding foreign trade, a representative of one of the large companies remarks as follows:

"England is the chief buyer. France also is a good customer. In Germany we do not sell much, owing to some matters relating to patents and to duties. Under the customs laws they are in the habit of admitting goods, if they want them, under one head or shutting them out under another head if they don't want them. We are establishing an agency in Copenhagen, opening up a field in the Scandinavian countries and Baltic provinces, and also working our way into South Africa."

WOOD-WORKING MACHINERY.

Indications at the beginning of this year have not been fulfilled. If it had not been for the war no doubt manufacturers would now be enjoying an era of prosperity, but as it is business drags along monotonously, and its volume is generally pronounced to be about the same as that of a year ago. There are, however, quite a number of inquiries. Some Government buying there has been, though not to an important extent. As far as local symptoms are a criterion, export orders are not numerous. Consumers may be glad to know that the "combine," the American Wood-Working Machinery Company, has not effected much or any increase in prices. One important concern, not in the consolidation, informs us that prices are more firmly held, which no doubt is true of its own, since it is one of the most prosperous companies, but sellers generally report that figures show

Continued on page 36.

▲ ▲ ▲

Business Specials.

Gear wheels, gear cutting. Grant; see page 16.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Conn.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Parallel drawing edge attachment; better than a T square, $1.25. F. G. Hobart, Beloit, Wis. Circulars.

Cutters, reamers and small tools, regular and special; vertical millers, cutter and surface grinders, shears and punches. R. M. Clough, Tolland, Conn.

Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted.

Mech. draftsman, 8 years exp. Box 75, AM. MACH.

Mech. draftsman, G. W., care of A. Haas, 108 Av. A., N. Y.

Mech. eng. wants pos. of responsblty. Box 101, AM. MA.

Mechanical draftsman; technical graduate; 1 yr. in drawing room and 10 yrs. as mach. Box 113, AM. MACH.

Position Wanted—A first-class die and toolmaker wants a steady position; will go anywhere for a good job. Box 109, AMERICAN MACHINIST.

Foreman patternmaker desires change; dry or green sand or loam, large or small; cheap or best work; best references. Box 110, AMERICAN MACHINIST.

Position wanted in or within 100 miles of New York City by first-class all round mach. and toolmaker; competent to take charge; age 27. Box 104, AM. MACH.

Wanted—Position as superintendent by thoroughly competent man (38); up to date in manufacture of machinists' tools; very best references; would not object to go abroad. Box 108, AMERICAN MACHINIST.

Wanted—A position as gen. sup't or manager; extensive practical exp. in metal working industries, including electrical apparatus, engines, power transmitting and mining mach., etc. Address Box 107, AM. MACH.

Wanted—Position by foreman patternmaker; age 39; eight years as foreman; thoroughly competent to run first-class shop; skilled in mill, mining, pumping and general machinery; best references. Address Box 105, AMERICAN MACHINIST.

Wanted—Supervision or management of plant offering opportunities of acquiring an interest, by one experienced in the latest Eastern foundry, forging mach. and boiler shop practice and shop manag't; now filling resp'e pos'n in plant emp. 1,200 men. Box 106, AM. MACH.

Help Wanted.

Wanted—First-class machinists and fitters. Charter Gas Engine Company, Sterling, Ill.

Agents in every shop to sell my line of tools; very liberal induc'm'nts. Address E. G. Smith, Columbia, Pa.

Wanted—A draftsman (in Ohio) who has had experience in engine work. Address stating experience, age, &c. Box 93, AMERICAN MACHINIST.

Wanted—A man that has had practical experience in camming and fitting tools on automatic screw machines; must be thoroughly competent to hold the job. Address Box 112, AMERICAN MACHINIST.

Wanted—Salesmen who call on manufacturers to sell two patented popular vises in connection with other lines they handle; liberal commission to right parties. Address P. O. Box 2347, New York City.

Wanted—Mechanical engineer of large experience, competent to take charge of drafting department in an establishment building Corliss engines and employing several hundred men. References and record of services required. Address Box 102, AMERICAN MACHINIST.

Wanted—An intelligent man of experience and system to take charge of a large bicycle factory; must be capable, energetic, with thorough mechanical knowledge of jigs and tools, and who will be able to reduce the cost of manuf. Address with terms, exp., age, reference, etc., to Factory, P. O. Box 1016, New York City.

Wanted—Energetic, honest and skillful man to take charge of one room in a manufacturing establishment; must be accurate machinist, good brass worker and understand finishing; he must be familiar with the construction of light, quick trains and the finish of fine instruments; apply at once stating age, exp., last position, references (not required); minimum pay will accept during thirty days' trial; regular pay desired if accepted. Address Fire Alarm, care of AM. MACH.

Continued from page 35.

no change. The American Wood-Working Machinery Company has not finished the adjustment of its internal affairs; to wit, the concentration of the scattered manufactories of which it is composed into a few centers. The consolidation has accomplished a better distribution and a better economy of selling agencies than was possible when the companies now belonging to it were independent. For instance, an order was taken some time since by one salesman where five would formerly have been competing.

The H. B. Smith Machine Company has opened a store at 65 South Canal street, Chicago. Connell & Dengler, Rochester, N. Y., have just placed their local agency in the hands of W. J. Reddy, 110 Liberty street, New York.

The works of the Berlin Machine Works, Beloit, Wis., one of the largest concerns that did not enter the consolidation, are running with an extra night force upon the milling machines which turn out parts of their machinery. The business centering in the Chicago and San Francisco offices is much in excess of the Eastern trade. The company has been the recipient of some orders incident upon the present war; for instance, it has received from two concerns contracts for machinery to be used in making boxes to hold cartridges for light artillery and has sold also machinery to prepare the inside woodwork of Government vessels.

MISCELLANEOUS.

The Cincinnati Milling Machine Company is about ready to occupy the new portion of its shop, and is looking for a further equipment of tools. Business is reported good, 75 per cent. of it foreign.

The works of the Jones & Lamson Machine Company, Springfield, Vt., have quite a little boom on at present.

There is a rumor that the North Kent Iron Works, England, are likely to purchase a large amount of machinery, including machine tools, in the United States.

To furnish engines for the electric plant of the United States public building, Louisville, Ky., the bid of the Buckeye Engine Company, Salem, Ohio, has been accepted. It is $5,000 in amount.

CHICAGO MACHINERY MARKET.

Wood-working machinery is temporarily behind a cloud on account of the general strike among the sash and door factory employés and kindred organizations. The men in the stone yards are also out on strike and a lull in that branch of the machinery trade is likewise discernible. Wood-working machinery, it may be said by way of parenthesis, is not what it once was, and it is more or less problematic whether the old times will return. Even in the iron-working machinery lines there is now more or less speculation as to the special direction that ac-

Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Best Calipers, Levels, etc. E. G. Smith, Columbia, Pa.

Book, Dies & Die Making, $1. J. L. Lucas, Prov., R. I.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Wanted—Some small machine to build by contract; A1 mechanics; new tools. Box 95, AM. MACHINIST.

For Sale—Second-hand drill presses, engine lathes and planers. Dietz, Schumacher & Boye, Cincinnati, O.

Wanted—A machine of latest construction for printing typewriter ribbons. Send full particulars with price to Box 97, AMERICAN MACHINIST.

Advertising Novelties Wanted—We will buy patents, manufacture for patentee or on a royalty, good advertising novelties Address P. O. Box 125, Erie, Pa.

A company employing 120 hands on small mechanical goods desires more favorable location, vicinity of Chicago preferred. Address Box 103, AM. MACHINIST.

The advertiser has a small manufacturing property and some money that he wishes to invest in manufacturing some staple article of merit Address E. C. Hart, 59 Dearborn street, Chicago, Ill.

Wanted—Manufacturer to buy or build on royalty best gas and gasoline eng. yet pat'd; perfectly balanced and entirely valveless; equally suited large and small powers, specially dynamos. Box 111, AM. MACHINIST.

The advertising department of the American Machinist has on hand 20,000 draftsman's thumb tacks; will send a box of ten to any draftsman in America on request; could use a postage stamp on box, but will send the tacks anyway.

Institutions retiring from business having machine tools, brass or wood working machinery, will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach Co, 55-59 Woodbridge st., W., Detroit, Mich.

S. WIENER,

Zwolle, Holland,

Invites correspondence with first-class manufacturers of

American Machinery AND TOOLS.

REFERENCES ON APPLICATION.

WOOD WORKERS

BUCK CAST BROS. STEEL

Chisels, Gouges, Turning Tools, Carving Tools. Pattern Makers' Gouges. *Send for Price List.*

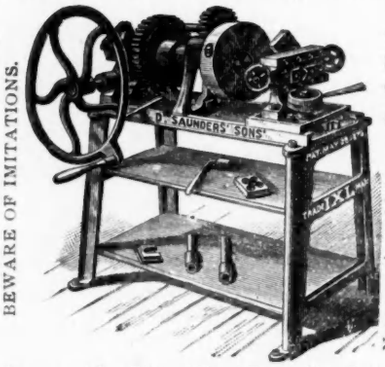
Buck Bros., Millbury, Mass.

D. SAUNDERS' SONS,

Manufacturers of the Original

TRADE **I. X. L.** MARK.

Pipe Cutting and Threading Machine.



BEWARE OF IMITATIONS. None genuine without our Trade Mark and Name.

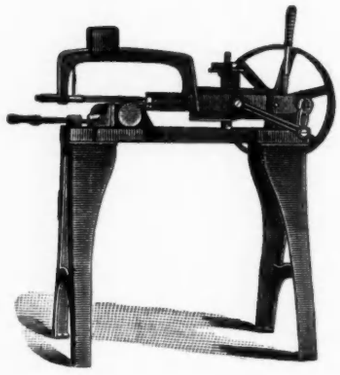
Steam and Gas Fitters' Hand Tools. Pipe Cutting and Threading Machines for Pipe Mill use a specialty.

SEND FOR CIRCULAR.

21 Atherton St., YONKERS, N. Y.

"The best is as good as any."

The New Automatic and Gravity Feed Q & C Shop Saw



Cuts { Tool Steel, Machinery Steel, Iron, Brass and All Other Metals.

Price—'Way Down.

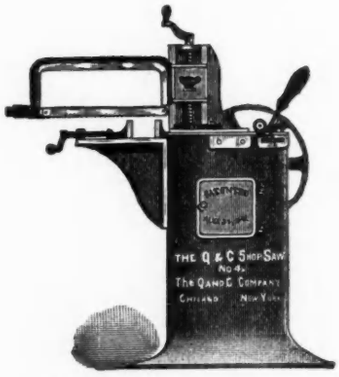
Quality—'Way Up.

Shop Saws,

Portable Rail Saws,

Cold Power Saws,

For All Purposes.



Send for Catalogue.

Q & C Company,

Chicago. New York.

LONDON: Chas. Churchill & Co.
PARIS: Hounsfield & Fils.
BERLIN: Schuchardt & Schutte
MADRID: J. G. Neville & Co.

tivity will take when it returns. During the past four or five years the bicycle and the electric industries have been the great saviors of the Western trade from extreme dullness. Much is expected of both these lines in the future, but it is hardly thought that they will bear the same relation to the market that they have done heretofore. There is at present some complaint by the bicycle makers that their foreign trade has diminished in volume. The assigned cause here is the difficulty of securing at the seaboard ocean-carrying room.

Considerable Government work is being done by the wagon works in the West. The specifications are outside of the ordinary, and by way of material some unusually large sizes of iron shapes have been purchased by the wagon men. One of these manufacturers is quoted as saying that if details were not so thoroughly provided for the results would be more satisfactory. There is no opportunity for the valuable improvements of the shop to be applied, the models adopted not being such as they would recommend. This new work has resulted in the sale of a little machinery, but not to any great amount.

Generally the machinery trade continues dull, and with little new feature. Some slight activity is noticed in the sewing machine line, where the manufacturers are making additions of special machinery in the interest of more economical production. They have been doing nothing in this direction for several years, but have finally come into the market in this way. The agricultural implement makers are the most active machinery users, and trade in the country is relatively better than in the city.

In crude iron the developments of the week have not been spectacular. There is dissatisfaction among sellers at the prices that are prevailing in bars, sheets and some other products, but the users are less discontented. The volume of business placed is less than it has been and signs of firmer quotations are hard to read.

Charles E. Davis, of Pratt & Whitney, reports that there is a fair demand for machinery, but that with them it is mainly for tools of their exclusive manufacture, purchased for special rather than general uses, to round out existing facilities for manufacture.

▲ ▲ ▲

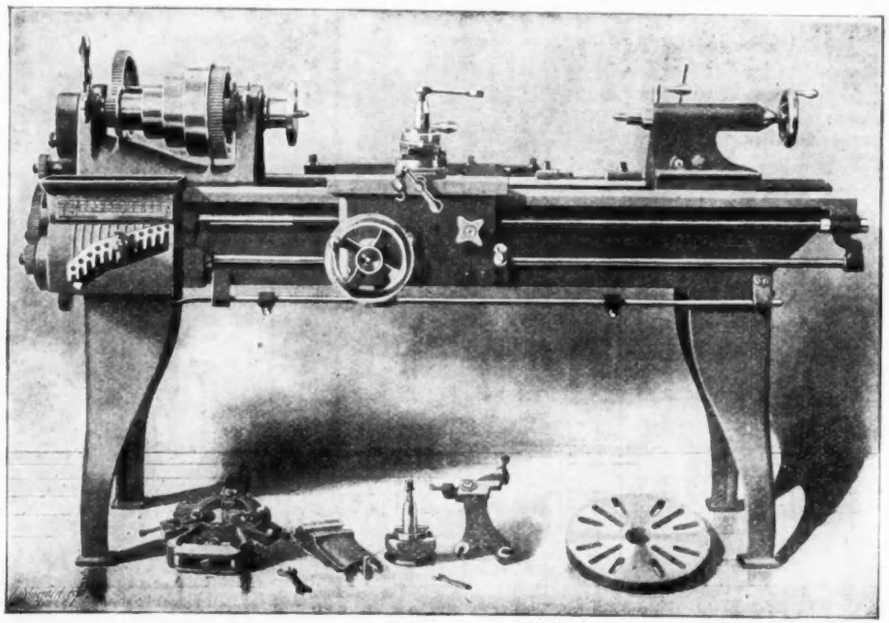
Quotations.

NEW YORK, Monday, June 20.

Iron—American pig, tidewater delivery:	
No. 1 foundry, Northern	$11 00 @ 11 50
No. 2 foundry, Northern	10 50 @ 11 00
No. 2 plain, Northern	10 00 @ 10 50
Gray forge, Northern	9 75 @ 10 00
No. 1 foundry, Southern	10 50 @ 10 75
No. 2 foundry, Southern	10 00 @ 10 25
No. 3 foundry, Southern	9 75 @ 10 00
No. 1 soft, Southern	10 50 @ 10 75
No. 2 soft, Southern	10 00 @ 10 25
Foundry Forge, Southern	9 50 @ 9 75
Bar Iron—Base—Mill price, in carloads, on dock: Common, 1.05@1.10c.; refined, 1.10@1.20c. Store prices: Common, 1.25@1.35c.; refined, 1.30@1.50c.	
Tool Steel—Base Sizes—Standard quality, 6@	

Quotations Continued on page 38.

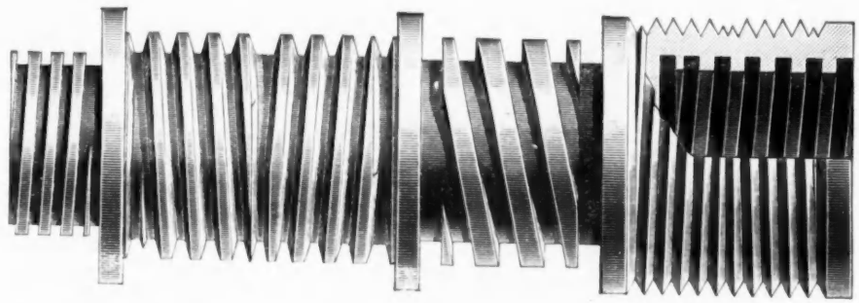
14 in. x 6 ft. Hendey-Norton Lathe.



THE HENDEY-NORTON ENGINE LATHE is the most modern type af engine lathe extant. Why? Because it has the best improved attachments known for the rapid and accurate production of high class lathe work in use on engine lathes at the present time.

One is the Norton arrangement of change gears for screw cutting. All the change gears are mounted in the gear box ready for use. The different pitches are obtained by the simple movement of handle in gear box from one notch to the other, carrying with it an intermediate gear meshing into the cone of change gears. Thus every thread required in ordinary use is obtained on the instant and this applies equally well to the feeds.

Another is the reversing lever at side of apron. At the moment of changing travel of carriage, as when cutting threads, you have but to move up or down this lever when the *carriage*—not the countershaft, belt, head spindle and work—returns in the opposite direction, and so on till work is finished. This saves wear and tear on working parts. In this specimen of thread cutting we have a good illustration of the application of the above features; but it is here shown to illustrate in particular what our Automatic Stop will do. It shows how threads can be cut to and from shoulders both internally and externally, tool stopping to a certainty, and with work in motion. This feature is equally applicable in turning work in duplicate. The Automatic Stop is at once positive and simple.



The Hendey Machine Co.,

Torrington, Conn.

AGENTS FOR THE PACIFIC COAST:
Pacific Tool and Supply Co., San Francisco, Cal.

J. W. Cregar, Philadelphia Bourse Exhibition.

EUROPEAN AGENTS:
Schuchardt & Schutte, Berlin, Vienna, Brussels, Stockholm.
Chas. Churchill & Co., Ltd., London and Birmingham, Eng.
Adolphe Janssens, Paris, France.

Quotations Continued.

7c., with some grades perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—Ordinary brands, from store, in small lots, 1.45 @ 1.50c.

Cold Rolled Steel Shafting—Base sizes, from store, 2.15 @ 2.20c., according to quantity.

Copper—Carload lots: Lake Superior ingot, 11¼ @ 11⅞c.; electrolytic, 11⅝ @ 11¾c.; casting copper, 11½ @ 11⅝c.

Pig Lead—Carload lots, 3.95c., f. o. b., New York.

Pig Tin—For 5 and 10 ton lots, 15.20 @ 15.25c., f. o. b.

Spelter—Carload lots, 5.15 @ 5.25c., New York delivery.

Antimony—In cask lots: Cookson's, 9½ @ 9⅝c.; Hallett's, United States and French E. B., 9c.; Japanese, nominally 9c., but little or none on the market.

Lard Oil—Prime city, present make, 52 @ 54c., according to brand and quantity.

▲ ▲ ▲

Manufacturers.

P. M. Claassen's new mill at Newton, Kan., is nearing completion.

The University of Kansas, Lawrence, Kan., is to erect a machine shop.

The plant of F. K. Gillespie Company, Stamford, Conn., was recently destroyed by fire.

The Taylor Silk Manufacturing Company, of Paterson, N. J., will build a new silk mill.

Paine & Co., Carlton, Minn., whose mill was recently destroyed, have decided to rebuild.

At Ludlow, Ohio, the shops of the Cincinnati Southern Railroad were recently destroyed by fire.

Walsh Brothers, of Janvier, N. J., are erecting a factory for the manufacture of Bohemian glassware.

The foundry and machine departments of the Watsontown (Pa.) Manufacturing Company were recently destroyed by fire.

The Wheeler & Wilson Sewing Machine Company is preparing to build an addition to its factory at Bridgeport, Conn.

L. Gerstle & Co. have commenced the erection of another addition to their medicine factory at Highland Park, Tenn.

The roundhouse and machine shop of the Au Sable & Northwestern Railroad, at McKinley, Mich., were recently destroyed by fire.

Philip Kennedy, of Scranton, Pa., and C. W. Etting, of Philadelphia, are interested in a brick plant likely to be located at Exeter, Pa.

The Schwarzschild & Sulzberger Packing Company, Kansas City, Mo., is contemplating making extensive additions to its Armourdale plant.

Rindge, Kalmbach, Logie & Co., of Grand Rapids, Mich., recently took out a permit for the erection of a factory building, which is to cost $50,000.

The Fred W. Wolf Company is preparing plans for a new brewery to be built for Adam Ginty & Co., at Chicago, Ill. The plant will cover 130x175 feet.

The block at the corner of First and Jackson streets, Oakland, Cal., has been sold to L. Bercovich and others, who are to erect a woolen mill on the premises.

The Seamless Metal Wear Company, of New York city, was recently incorporated by Adolph E. Borie, B. Lockwood and others to engage in the manufacture of metal ware.

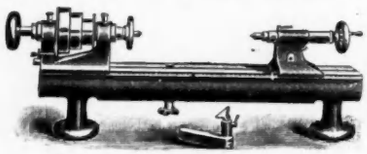
The A. L. Sweet Iron Works, of Medina, N. Y., has been incorporated by A. L. Sweet, L. M. Sweet, A. J. Howard and others.

Thomson & Boyle Company has been formed at Sacramento, Cal., to manufacture boilers. Directors—H. D. Thomson, J. L. Boyle, B. T. Davies, R. J. Boyle, all of Los Angeles, Cal.

The certificate of incorporation of the White Plains Lighting Company, formed for the manufacture and use of electricity for producing light, heat and power, and in lighting streets and publice and private buildings, has been filed. The

No. 3 Bench Lathe, 7 in. Swing, 32 in. Bed,

Is furnished without and with Thread Cutting, Filing and Milling attachments; Back, Jeweling Slide and Drill Rests; Graduating Head or Dividing Engine, Chucks, etc.



Hand Bench Milling and Profiling Machines; Sub-Press Bases and Stands with Dies.

Special attention given to Manufacturers' Models and Plants for Manufacturing on the Interchangeable System.

Ask for the Machinists' Catalogue.

The Pratt & Whitney Company,
HARTFORD, CONN., U. S. A.

NEW YORK: 123 Liberty Street. BOSTON: 144 Pearl Street. CHICAGO: 42 South Clinton Street. LONDON, ENGLAND: Buck & Hickman, 280 Whitechapel Road. PARIS, FRANCE: Fenwick Freres & Co., 21 Rue Martel.

ENGINE and SPEED LATHES

IN VARIOUS LENGTHS—9 to 15 in. SWING.
Latest and Most Approved Designs. Workmanship, Material and Finish of the Highest Order.

SEBASTIAN LATHE COMPANY,
117 and 119 Culvert Street, CINCINNATI, OHIO, U. S. A.
Agents: SELIG, SONNENTHAL & CO., London, Eng.; JOHN TRAGARDH & CO., Göteborg, Sweden; E. SONNENTHAL, JR., Berlin, Germany; R. S. STOKVIS & ZONEN, Rotterdam, Holland.

THIRD EDITION. THIRD THOUSAND.

Kent's Mechanical Engineers' Pocket Book.

1,100 pages, 12mo., morocco flap, $5.00. Postpaid on receipt of price.

John Wiley & Sons, 53 E. 10th Street, New York City.

GENUINE LIGHTNING SCREW PLATES,

Taps, Dies, Reamers, Green River Screw Plates, Bolt Cutters, Drilling Machines, etc.

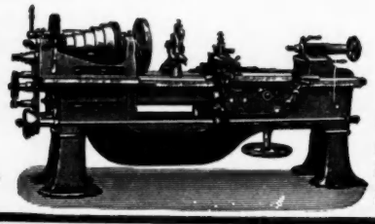
Send for Catalogue.

WILEY & RUSSELL MFG. CO.
GREENFIELD, MASS., U. S. A.
Agts in London, SELIG, SONNENTHAL & CO., 85 Queen Victoria St.

PUTNAM MACHINE CO.,

The Oldest and Most Extensive Builders of Lathes in America.

LATHES, PLANERS, DRILLING MACHINERY, MILLING MACHINES, SLOTTERS, SHAPERS, GAP ENGINE LATHES.



RAILROAD SHOP TOOLS, GAP PATTERN MAKERS' LATHES, &c.
Correspondence Solicited.
8 to 100 Putnam St.
Fitchburg, Mass., U. S. A.

WE CLAIM THE FOLLOWING MERITS FOR **JENKINS BROS.' VALVES.**

1. Manufactured of the best Steam Metal.
2. No regrinding, therefore not constantly wearing out the Seat of the Valves.
3. Contain JENKINS DISC, which is suitable for all Pressures of Steam, Oil and Acids.
4. The Easiest Repaired, and all parts Interchangeable.
5. Every Valve Tested before leaving the factory.
6. ALL GENUINE stamped with Trade Mark.

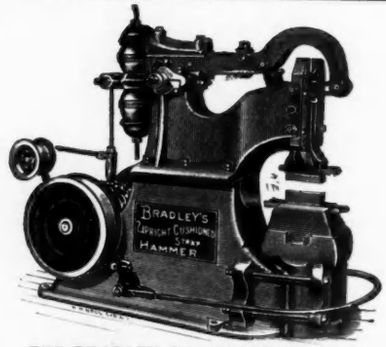
JENKINS BROTHERS, New York, Philadelphia, Chicago, Boston.

BRADLEY HAMMERS

Have never been equaled for quantity and quality of output, simplicity, durability and freedom from repairs.

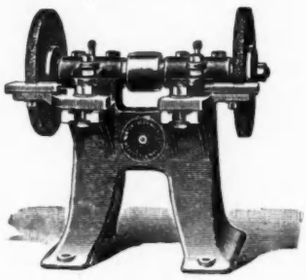
Send for Circulars.

Foreign Agents:
Buck & Hickman, Whitechapel Road, London.
Schuchardt & Schutte, Berlin, Vienna, Brussels.
Fenwick Freres & Co., Paris.



THE BRADLEY CO., SYRACUSE, N. Y.

We Make **Boring Machines, Milling Machines, Special Tools** BEAMAN & SMITH, PROVIDENCE, R. I.



This Little Bench Grinder

is made by the Norton Emery Wheel Co.—that is a sufficient guarantee for quality and workmanship.

Another interesting feature is the price.

We'd rather write you about that.

Norton Emery Wheel Co.

Worcester, Mass., U. S. A.

"Diamond" Grinders are all right, every time. Write for catalogue.

Diamond Machine Co.,

Providence, R. I., and Chicago, Ill.

London: Chas. Churchill & Co., Ltd.
Berlin: Garvin Machine Co.
Copenhagen: V. Lowener.
Paris: Fenwick Frères.

E. W. BLISS CO.

1 Adams St., Brooklyn, N. Y.

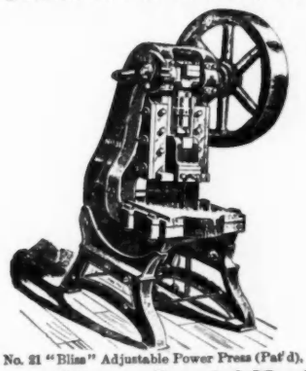
CHICAGO: 96 W. WASHINGTON ST.

EUROPEAN OFFICE:

31 RUE CAUMARTIN, PARIS, FRANCE—A. WILZIN, Mgr.

OWNING AND OPERATING

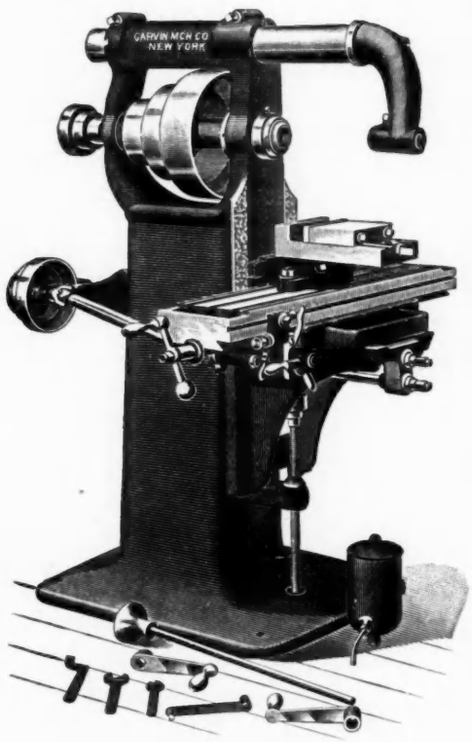
THE STILES & PARKER PRESS CO.



No. 21 "Bliss" Adjustable Power Press (Pat'd).

Presses, Dies and Special Mach'y.

Manufacturers of the WALDRON FRICTION CLUTCHES.



No. 13 Plain Milling Machine.

Milling Machines

IN GREAT VARIETY.

Plain, Universal, Hand, Lincoln, Duplex, Vertical and Sprocket Wheel Millers.

Index Centers, Dividing Heads, Vertical Spindle Attachments, Vises, Etc.

Machine Tools and Machinery.

The Garvin Machine Co.,

Spring and Varick Sts., NEW YORK.

Philadelphia Store: THE GARVIN MACHINE CO., 51 North 7th Street, Philadelphia, Pa.
Berlin Store: THE GARVIN MACHINE CO., m. b. H., 17 Burg Strasse, Berlin, C., Germany.
Agents for Great Britain: C. W. BURTON, GRIFFITHS & CO., 23a Ludgate Hill, London, E. C., England.

amount of the capital stock is $50,000. The directors are Winthrop G. Bushnell, New Haven, Conn.; Joseph L. Hall, Port Chester, N. Y., and John C. Bennett, Brooklyn, N. Y.

A new industry will be erected at Norway Park, Pa. It will be a match factory, with a capital stock of $50,000. The promoters of the enterprise are W. F. Bay Stewart, of York, Pa., and Samuel Bailey, of Lancaster, Pa. The new enterprise will be known as the York Match Company.

The Valley Rubber Company's works, New Philadelphia, Ohio, were destroyed by fire recently. The plant was valued at $13,000. The officers of the company are: Dr. L. B. Sweitzer, president; W. B. Davis, vice-president; S. M. Anderson, secretary, and John Kaderly, treasurer. The president, vice-president and secretary reside in Akron, Ohio.

The Moore Manufacturing Company, of Cleveland, Ohio, has changed its company name to "The Chisholm & Moore Manufacturing Company," and has increased its capital stock to $150,000. The company has bought 266x331 feet on the corner of Lake and Kirtland streets, Cleveland, and is erecting a brick building, with iron trussed slate roof.

The directors of the A. W. Stevens Company, of Marinette, Mich., have adopted the plans for the new factory as submitted by Ferry & Clas, the Milwaukee architects. There will be ten buildings on the site, including the main building, which will be a structure two stories high, with several wings. It will be 190x60 feet, with two wings, one 240x60 and the other 160x60 feet, all solid brick.

The new power house now being erected by the Port Chester Street Railway Company, of Port Chester, N. Y., is a building 45x84 feet, and consists of a boiler room, engine and dynamo room. The building has brick side walls in which are built steel columns supporting steel truss roof. In the engine room is a traveling crane arranged so that any part of the engines or dynamos on the floor below can be readily lifted and moved from one place to another. The power house is built in a substantial manner, and is a well designed modern station in every respect. The steel work for this building was designed and is being erected by the Berlin Iron Bridge Company, of East Berlin, Conn.

▲ ▲ ▲

New Catalogs.

There are three sizes of Standard Catalogs, first authorized by the Master Car Builders' Association, 9" x 12", 6" x 9" and 3½" x 6". We recommend the 6" x 9" size for machinery catalogs. When they must be larger or smaller, one of the other standard sizes should be adopted if possible.

We have received from the Phosphor-Bronze Smelting Company, Limited, Philadelphia, Pa., its 1898 price list of phosphor-bronze in both wire and sheet and other alloys.

The Miller, Duhme & Peters Manufacturing Company, Cincinnati, Ohio, sends us catalog of cigar and cigarette machinery, also machinery for packing cigars. The catalog is 6¼x9 inches.

We have received from the Hoppes Manufacturing Company, Springfield, Ohio, copy of catalog illustrating and describing the Hoppes feed water heaters and feed water purifiers. The catalog is standard size, 6x9 inches.

The Standard Pneumatic Tool Company, Chicago, Ill., sends us Catalog C of pneumatic drills, boring machines, hammers and other tools operated by compressed air. These tools are used in railroad work, boiler and bridge work. The catalog is 6x9½ inches.

J. E. Snyder, Worcester, Mass., has sent us catalog of post drills, gang drills, back geared upright drills. These drills are fitted with roller thrust bearings. The catalog also contains illustrations and descriptions of drill chucks, twist drills, etc. The catalog is standard size, 6x9 inches.

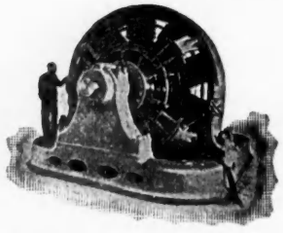
HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.
HARTFORD, CONN.

J. M. ALLEN, President.
WM. B. FRANKLIN, Vice-President.
F. B. ALLEN, Second Vice-President.
J. B. PIERCE, Secretary and Treasurer.

WALKER COMPANY

ELECTRICALLY DRIVEN

Cranes and Hoists,
Motors for Mills
and Factories.



Generators for
Lighting and Power,
Mining Machinery, Etc.

CLEVELAND, OHIO.

Columbia University
in the City of New York.

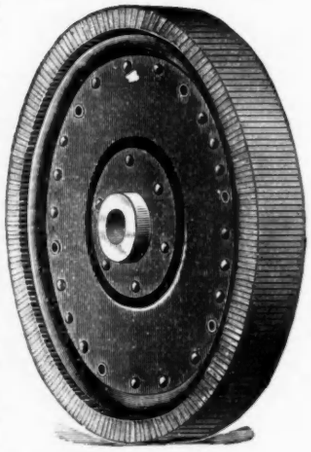
SCHOOL OF MINES,
SCHOOL OF CHEMISTRY,
SCHOOL OF ENGINEERING,
SCHOOL OF ARCHITECTURE,
SCHOOL OF PURE SCIENCE.

Four years' undergraduate courses and special facilities for graduate work in all departments. Circulars forwarded, on application, to the Secretary of the University.

For Heavy Continuous Work

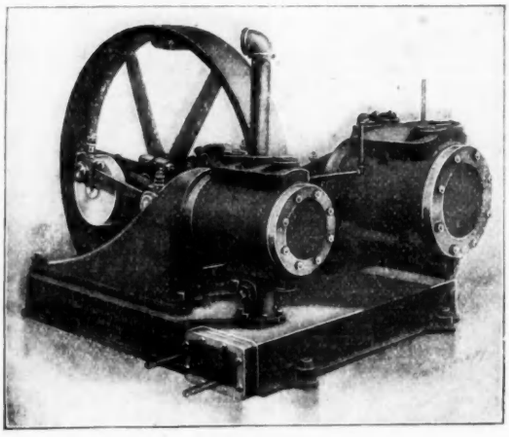
every machine shop will commend our Power Pipe Threading and Cutting Machine. Cones are central over machine, equalizing the weight. Within the cones are compound gears giving six changes of speed. Gears require no extra space, and are protected from dust or accident. Chasers can be opened threaded pipe removed, another inserted and cut without stopping machine

SEND FOR CATALOGUE.
THE MERRELL MFG. CO.,
100 Curtiss St., Toledo, Ohio.



POLISHING WHEELS.

COMPRESS WHEEL CO.,
16 North Canal St., Chicago, Ill.



Duplex Class "J" Compound.

Air Compressor

This type of machine represents the most durable, compact and economical of small and medium size air compressors. Automatic in action, thorough system of intercooling.

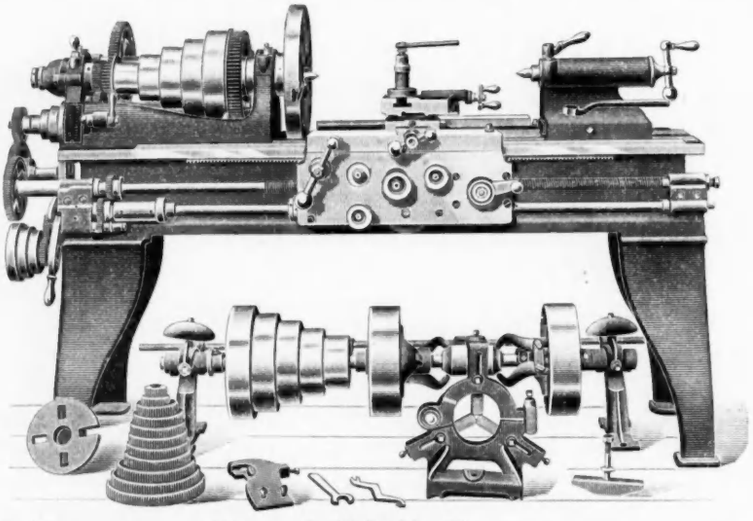
May be driven by belt, water or electric motor, gas or oil engines.

Rock Drills, Channelers, Coal Cutters, the Pohle Air Lift Pump.

THE Ingersoll-Sergeant Drill Co.,

Havemeyer Building,
New York.

Of course you want the best—that is the "Bradford."



14, 16, 18, 21, 25, 31 and 36 inch.

Beds any length desired.
English or metric screws.
Any form of tailstock.
Patented feed arrangement.

Feeds can be driven with either belt or gearing without disconnecting either. Lathes are furnished complete. Compound rest and improved taper attachment if desired. These Lathes are adapted to handling either light or heavy work and are all carefully tested before leaving our works. Write for Catalogue A to

The Bradford Mill Company, Cincinnati, Ohio, U. S. A.

Lieber's Code used. Cable address: "Stewart, Cincinnati."

Charles Churchill & Co., Ltd., London and Birmingham.
Schuchardt & Schutte, Berlin, Vienna, Brussels, Stockholm.
Adolphe Janssens, Paris, France.
The E. A. Kinsey Co., Cincinnati, Ohio.
Pacific Tool and Supply Co., San Francisco, Cal.
J. A. Fay & Egan Co., Chicago, Ill.
J. W. Wright & Co., St. Louis, Mo.
Philadelphia Bourse, Philadelphia, Pa.

Index to Advertisers.

PAGE.

Acme Machinery Co. 16
Acme Malleable Iron Works. 46
Adams, Co., The. 47
Albro-Clem Elevator Co. 10
Almond, T. R. 2
American Gas Furnace Co. 2
American Tool & Mach. Co. 7
American Tool Works Co. 45
Armstrong Bros. Tool Co. 12
Armstrong Mfg. Co. 46
Atha & Illingsworth Co., Benj. 2

Backus Water Motor Co. 41
Baird & Co., Henry Cary. 3
Baird Machinery Co., U. 13
Baker Bros. 4
Baldwin, Davidson & Wight. 44
Ball Bearing Co. 16
Barnes Co., W. F. & John. 41
Bardons & Oliver. 45
Beaman & Smith. 38
Becker Mfg. Co., John. 15
Bement, Miles & Co. 39
Bentel & Margedant Co., The. 3
Berlin Iron Bridge Co. 47
Besly & Co., Chas. H. 48
Bethlehem Foundry & Machine Co. 2
Bethlehem Iron Co. 44
Bickford Drill & Tool Co. 47
Bignall & Keeler Mfg. Co. 43
Bilgram, Hugo. 4
Billings & Spencer Co. 43
Bliss Co., E. W. 43
Boston Gear Works. 41
Bradford Belting Co. 38
Bradford Mill Co., The. 15
Brainard Milling Machine Co. 44
Bristol Co. 48
Brown & Co., R. H. 3
Brown & Sharpe Mfg. Co. 48
Buck Bros. 16
Buckeye Engine Co. 47
Buffalo Forge Co. 48
Builders' Iron Foundry. 2
Bullard Machine Tool Co. 7
Bullock Electric & Mfg. Co. 33
Burr Mfg. Co. 47
Burt Mfg. Co. 35

Carborundum Co., The. 4
Card Mfg. Co., S. W. 12
Case Mfg. Co. 44
C & C Electric Co. 44
Chambersburg Engineering Co. 46
Chandler & Taylor Co. 46
Cincinnati Milling Machine Co. 42
Cleveland Machine Screw Co. 4
Cleveland Twist Drill Co. 48
Coffin & Leighton. 44
Columbia University. 3
Compress Wheel Co. 8
Cook Co., Asa S. 4
Crescent Steel Co. 8
Crosby Steam Gage & Valve Co. 46
Curtis & Co. Mfg. Co. 39
Curtis & Curtis. 4
Cushman Chuck Co. 3

Dallet & Co., Thomas H. 10
Detrick & Harvey Machine Co. 47
Dixon Crucible Co., Joseph. 2 and 10
Doan & Co., J. B. 13
Draper Machine Tool Co. 5
Dreses, Mueller & Co. 15
Dwight-Slate Machine Co. 47

Eames Co., G. T. 2
Errington, F. A. 3
Evans Friction Cone Co. 41

Fay & Scott. 7
Fellows Gear Shaper Co. 8
Fifield Tool Co. 48
Flather & Co. 7
Foos Gas Engine Co. 46
Forbes & Co., W. D. 46
Foster, Walter H. 39
Fricke Co., The. 46

Gang & Co., Wm. E. 43
Garvin Machine Co., The. 12
General Electric Co. 38
Geometric Drill Co. 3
Gisholt Machine Co. 14
Gleason Tool Co. 16
Goddard Machine Co. 7
Goodyear, S. W. 4
Gould & Eberhardt. 16
Grant Gear Works. 16
Gray Co., G. A. 16

Hampden Corundum Wheel Co. 3
Harrington & King Perforating Co. 48
Hart Mfg. Co. 43
Hartford Steam Boiler Insp. & Ins. Co. 12
Henderer's Sons, A. L. 12
Hendey Machine Co. 36
Henley & Co., N. E. 43
Hill, Clarke & Co. 13
Hoggson & Pettis Mfg. Co. 3
Horton & Son Co., E. 3
Hurlbut-Rogers Machine Co. 3
Hyatt Roller Bearing Co. 2

PAGE

Ingersoll-Sergeant Drill Co. 13
Ingersoll Milling Machine Co. 10
International Correspondence Schools. 8

Jenkins Bros. 37
Jessop & Sons, Wm. 4
Jones & Co., B. M. 2
Jones & Lamson Machine Co. 1 and 16

Keasey, Theron D. 44
Kelley Machine Co., R. A. 10
Kempsmith Machine Tool Co. 35
Keuffel & Esser Co. 35
Keystone Electric Co. 38

Landis Tool Co. 42
Le Blond, R. K. 48
Le Count, Wm. G. 3
Lodge & Shipley Machine Tool Co. 6
Long & Alstatter Co. 4

Mackey Company, Ltd., The. 10
Main Belting Co. 47
Mass. Charitable Mechanic Association. 10
McCabe, J. J. 13
Mergenthaler & Co., Ott. 8
Merrell Mfg. Co. 8
Mianus Electric Co. 46
Mietz & Weiss. 46
Monarch Mfg. Co. 46
Moore Cycle Fittings Co. 13
Morse Twist Drill & Machine Co. 15
Morse, Williams & Co. 44
Morton Mfg. Co. 43
Mossberg & Granville Mfg. Co. 5 and 13

New Doty Mfg. Co. 38
New Era Iron Works. 46
New Haven Mfg. Co. 4
New Process Raw Hide Co. 41
Newton Machine Tool Works, Inc. 8
Nicholson File Co. 8
Niles Tool Works Co. 11 and 16
Niles Tool Works Co., New York Branch. 13
Norton Emery Wheel Co. 37

Oesterlein, W. 10
Oster Mfg. Co. 10

Page's Sons, Isaiah. 46
Pearson Machine Co. 48
Pierce Engine Co. 46
P. O. Box 1435. 13
Pope Tube Co. 6
Powell Planer Co. 10
Pratt Chuck Co. 3
Pratt & Whitney Co. 37
Prentiss Tool & Supply Co. 12
Purdue University. 44
Putnam Machine Co. 37

Q & C Co. 35
Quint, A. D. 13

Rand Drill Co. 46
Reed Co., F. E. 41
Reeeves Pulley Co. 10
Rogers Boat, Gage & Drill Works, John. 39
Rue Mfg. Co. 46

Safety Emery Wheel Co. 44
Saunders' Sons, D. 43
Sawyer Tool Co. 8
Sebastian Lathe Co. 37
Sellers & Co., Inc., Wm. 16
Seneca Falls Mfg. Co. 10
Shriver & Co., T. 41
Shultz Belting Co. 16
Sibley & Ware. 41
Skinner Chuck Co. 3
Slocomb & Co., J. T. 8
Smith & Mills. 43
Spencer Auto. Mch. Screw Co. 44
Springfield Gas Engine Co., The. 46
Springfield Machine Tool Co. 42
Standard Machine Co. 7
Standard Tool Co. 48
Starrett Co., L. S. 10
Steel Ball Co. 43
Stevens Arms & Tool Co., J. 8
Stiles Press Co., E. S. 4
Stover Novelty Works. 4
Stuart's Foundry & Machine Works, R. J. 48
Sturtevant Co., B. F. 49

Tabor Mfg. Co. 46
Tampograph Co., The. 2
Tight Joint Co. 41
Timolat, J. G. 43
Toledo Machine & Tool Co. 3
Toomey, Frank. 13
Trump Bros. Machine Co. 3
Turner, Vaughn & Taylor Co. 3
T. & B. Tool Co. 16

Wais & Roos Punch & Shear Co. 47
Walcott & Sons, Geo. D. 8
Warner & Swasey. 48
Washburn, Reginald. 43
Wassidlo & Co. 35
Watkins Co., F. M. 46
Watson-Stillman Co., The. 7
Weber Gas & Gasolene Engine Co. 46
Webster Mfg. Co. 46
Webster & Perks Tool Co. 44
Weiner, S. 35
Wells Bros. & Co. 12
Westinghouse Electric & Mfg. Co. 38

PAGE

Whitcomb Mfg. Co. 2
Whitney, Baxter D. 7
Whiton Machine Co., D. E. 3
Wiley & Sons, John. 37
Wiley & Russell Mfg. Co. 37
Woodward & Rogers. 4
Worcester Machine Screw Co. 4
Wyke & Co., J. 41
Wyman & Gordon. 48

York, S. M. 13
Young Mfg. Co., W. C. 42

▲ ▲ ▲

Contents.

PAGE.

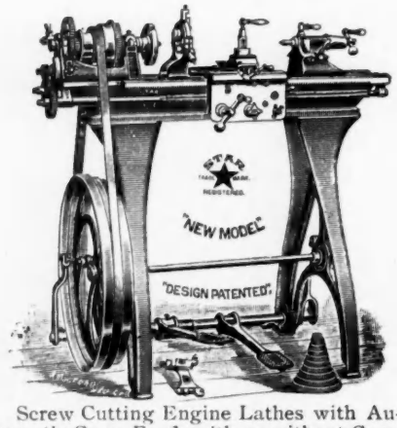
Dimensions of Gear Teeth in the Metric System. By Peder Lobben. 17
Aluminum Oil Cups. 17
An Automatic Four Plunger Drawing Press 18
Shop Tools Driven by Compressed Air—IV. The Pneumatic Jack... 19
The Best Shop Schooling. 20
An Example of English. 21
Three Modifications of the Geneva Stop. 21
Piston Packing Rings. By W. H. Wakeman 24
A Quick Adjusting Depth Gage. 24
The Cost of Fuel Gas. By E. P. Reichhelm. 25
Organization Meeting of American Section International Association for Testing Materials. 25
Letters from Practical Men: Spirit Inventions. By J. H. Snow & Co. ....A Milling Job.—Foreign Made Sewing Machines. By R. J. Hearne...Pickling Castings. By Otto W. Schaum....The Power of Windmills. By S. G. Cleaver.... Another Centrifugal Pump. By A. H. Lefebare....The Drag of the Feathering Paddle Wheel. By Morris Fulton....Truing Milling Cutters.—Drilling Records. By All-Round Machinist....The Sang Generated Gear Tooth. By E. R. Fellows....Countershafts and Loose Pulleys. By Tecumseh Swift....Plotting Belt Holes in Floors and Partitions by Proportion. By M. H. Avery. 26-31
An Improved Drill Gage. 31
An Analogy Between Tire Widths and Machine Design. 32
Government Control of Railroads in Russia 32
Questions and Answers. 32
Foreign News Notes 33
Death of M. Schneider. 33
Personal 33
Machinery Wanted by the Navy. 33
Obituary 33
Commercial Review. 34

50 cents
Machine Shop Arithmetic.

American Machinist,
256 Broadway, New York.

Star Foot Power Lathes

9 and 11 inch Swing.



Screw Cutting Engine Lathes with Automatic Cross Feed, with or without Compound Rest, Friction Countershaft, etc Contain new and original features especially adapted for Bicycle, Electrical and Accurate Machine Shop Service.

Send for Catalogue B.

Seneca Falls Mfg. Co.,

687 Water St., Seneca Falls, N.Y., U.S.A.

TOOLS

Our new Catalogue of Fine Mechanical Tools, Milling, Gear and other Cutters, 112 pages, will be sent free to anyone who asks for it.

THE L. S. STARRETT CO.,
Box 59, Athol, Mass., U. S. A.

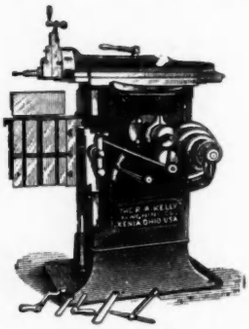
Crank Shapers

15, 16 and 20 in.

Quick Adjustment. Powerful and accurate in construction.

Easy of operation.

Write us about them.



The R. A. Kelly Machine Co.,

P. O. Box 553,
Zenia, Ohio,
U. S. A.

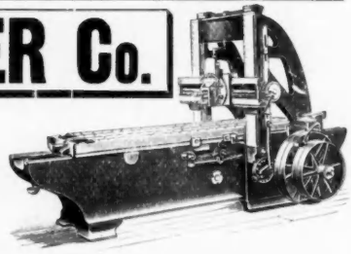
Established 1891.

POWELL PLANER Co.

WORCESTER, MASS.

AGENTS:

U. Baird Machinery Co., 125 Water St., Pittsburg, Pa.
J. A. Fay & Egan Co., 26 South Canal St., Chicago, Ill.
Robinson & Cary Co., St. Paul, Minn.
Colcord & Sanderson, 502 North Second St., St. Louis, Mo.
Parke & Lacy Co., Fremont St., San Francisco, Cal.
The Fairbanks Co., 705 Arch St., Philadelphia, Pa.



MILLING MACHINES PLAIN AND UNIVERSAL.

W. OESTERLEIN, 307 WEST SECOND STREET, CINCINNATI, OHIO.

HINDLEY AND ALBRO

Worm Gearing.

Consumes less power and gives better results than the old style worm gearing.

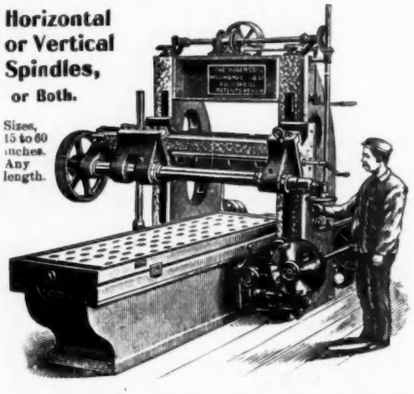
Albro-Clem Elevator Co.,
Philadelphia, Pa.,
U. S. A.

Adjustable Stock & Dies

The Oster Mfg. Co.,
49 East Prospect St., CLEVELAND, O.

Horizontal or Vertical Spindles, or Both.

Sizes, 15 to 60 inches. Any length.



THE INGERSOLL MILLING MACHINE CO.,
Box 2777. Rockford, Ill., U. S. A.

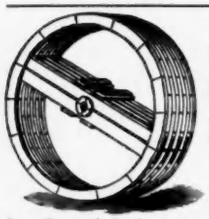
THOS. H. DALLETT & CO.,
PHILADELPHIA,

MANUFACTURERS OF

Portable Drills, Hand Drills,
Boiler Shell Drills,
ELECTRIC
DRILLS.

THUMB TACKS and every other requisite for the Drawing Room.

Send for Illustrated Catalogue. THE MACKEY COMPANY, LIMITED: PITTSBURGH, PA.



"The Reeves" Wood Split Pulley,

with interchangeable bushing system for belt power transmission.

Lighter than an iron pulley. Stronger than a steel pulley. Each pulley will fit thirty-five sizes of shaft. No set screws. No keyway. Complete stocks carried in every jobbing center in the United States. Also:

CHAS. CHURCHILL & Co., 9 to 15 Leonard St., London, Eng.
SCHUCHARDT & SCHUTTE, Berlin, Brussels, Milan.
FENWICK FRERES & Co., 21 Rue Martel, Paris, France.
WHITE, CHILD & BENEY, Vienna, Austria.

Reeves Pulley Co., Columbus, Ind., U. S. A.,
Send for Catalogue. **Manufacturers.**

One-half a million people will visit the Twentieth Triennial Exhibition of the Massachusetts Charitable Mechanic Association, October and November, 1898.

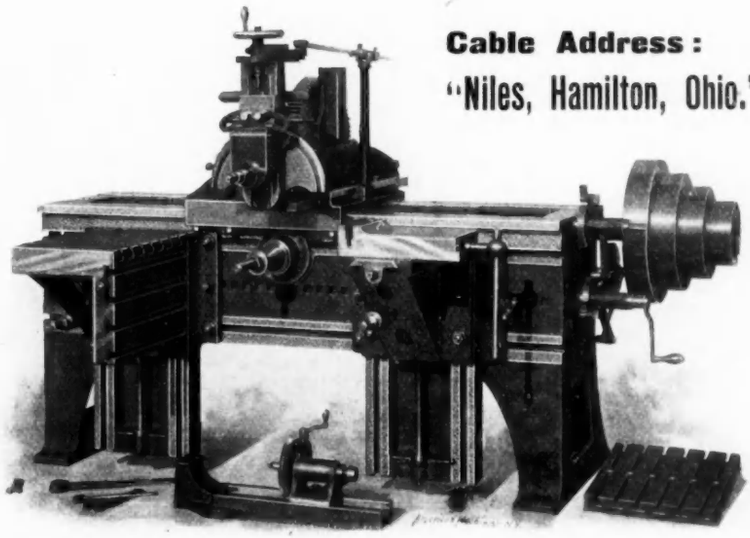
ELECTRICIANS AND MANUFACTURERS OF ELECTRICAL APPARATUS

who wish to avail themselves of this opportunity should send for prospectus, rules and conditions and application form for space. Entrance fee for electrical and mechanical exhibits only five dollars. No charge for space or power. All machinery electrically driven. Plans and full particulars on application to HENRY D. DUPEE, Secretary Executive Committee, Mechanics Building, Boston, Mass.

DIXON'S AMERICAN GRAPHITE ARTIST'S VVV H = HHHHHHH

SOMETHING NEW. DRAUGHTSMEN'S DELIGHT, Sample 10 Cents. Try One.
JOS. DIXON CRUCIBLE CO.
JERSEY CITY, N. J.

THE NILES TOOL WORKS CO.



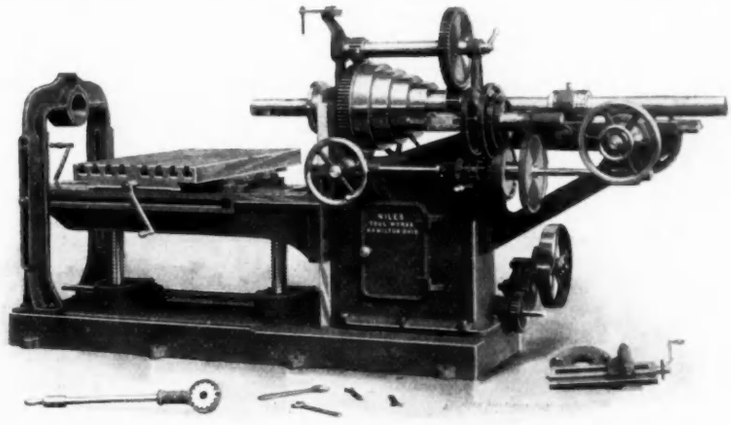
Cable Address:
"Niles, Hamilton, Ohio."

18 IN. SHAPING MACHINE, TRAVELING HEAD.
ALL SIZES, ONE OR TWO HEADS.

BRANCHES:
New York. Chicago. Pittsburg. Philadelphia. Boston. St. Louis.
39 Victoria Street, London, S. W. (Telegrams: NILIACUS.)

MAIN OFFICE AND WORKS:
HAMILTON, OHIO.

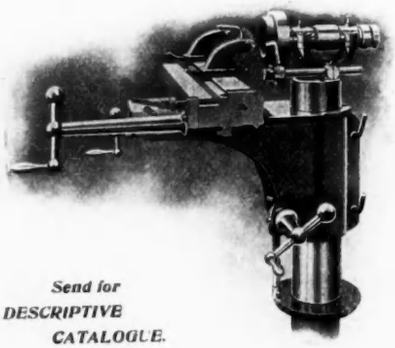
AGENCIES:
Paris, H. Glaenzer & Co. Berlin, G. Deichmann & Sohn.
Copenhagen, V. Löwener. St. Petersburg, "Atalanta" Technical Agency.
Helsingfors, Werner Hult. Johannesburg, Sheriff, Swingley & Co.



No. 2 1-2 HORIZONTAL BORING and DRILLING MACHINE.
Bores to Center of a 60 in. Circle.
ALL SIZES.

MACHINE TOOLS.

Cut showing how to grind milling Cutters.
We use cup wheel.



Send for DESCRIPTIVE CATALOGUE.

New Universal Grinder.
WELL BROS. & CO., GREENFIELD, MASS

Hydraulic Head Punches.

IN LARGE AND SMALL SIZES.

Adapted for the same use as Screw Punches, but being much easier and quicker worked, thus requiring but one man to operate it.

These are money savers for Boiler Makers, Bridge Builders and Sheet Iron Workers. Our Jacks, Tube Expanders and Pipe Vises will interest you.

A. L. HENDERER'S SONS,
85 Maryland Avenue,
WILMINGTON, DEL.

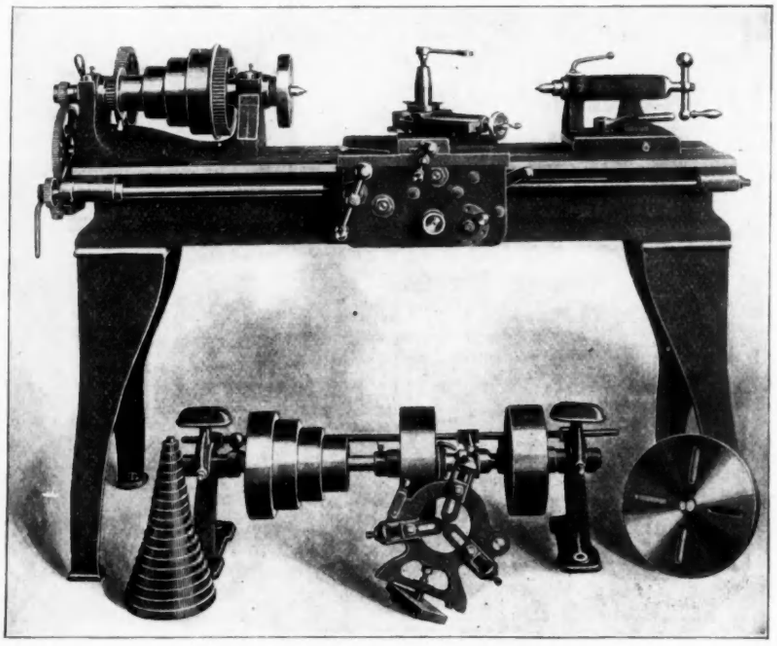
A. W. SECOR, Agent,
123 Liberty Street, New York.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.
HARTFORD, CONN.

J. M. ALLEN, President.
WM. B. FRANKLIN, Vice-President.
F. B. ALLEN, Second Vice-President.
J. B. PIERCE, Secretary and Treasurer.

ARMSTRONG LATHE AND PLANER TOOL.
Saves Forging, Tool Steel, Time.
Send for Catalogue.

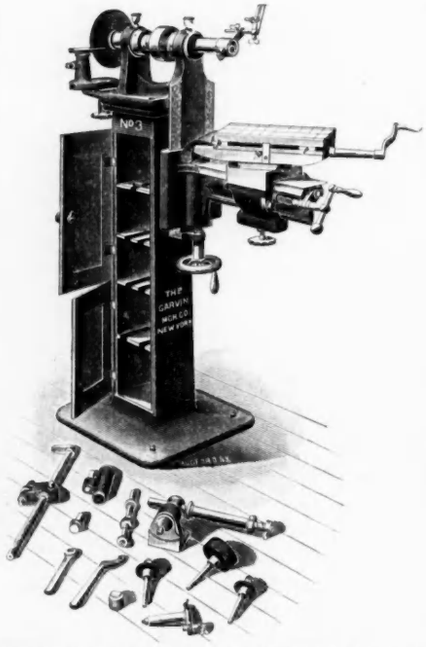
ARMSTRONG BROS. TOOL CO. 98 West Washington St. CHICAGO, ILL.



13 inch Prentiss Special Lathe.
Especially designed for export. Write for full particulars and prices.

Prentiss Tool & Supply Co.,
Machine Tools,
Cable address: "Prenco."
Branches: Chicago. Cleveland, Buffalo. **115 Liberty Street, New York.**

Spring Screw-Threading Die.
"The Card Kind."
S. W. Card Mfg. Co.,
Mansfield, Mass.



Our

No. 3 Universal Cutter and Tool Grinder has many superior advantages you cannot afford to overlook in your selection of a machine. We have a book describing the use of this and our other cutter grinders. Yours for a postal.

Machine Tools and Machinery.

The Garvin Machine Co.
Spring and Varick Sts.,
NEW YORK.

Philadelphia Store: 51 North 7th Street, Philadelphia, Pa.

Berlin Store: THE GARVIN MACHINE CO., m. b. H., 17 Burg Strasse, Berlin, C., Germany.
Agents for Great Britain: C. W. BURTON, GRIFFITHS & CO., 23a Ludgate Hill, London, E. C., England.

Second-Hand Tools.

Large Floor Boring and Drilling Machine.
Upright Boring and Turning Mill, 12 ft.
Slotter, 18-in. stroke, automatic feeds.
Triple-geared Lathe, 90-in. swing
Universal Radial Drill, 13-ft. swing.
Semi-Universal Radial Drill, 84-in. swing.
Brown & Sharpe No. 1 Universal Grinder, latest.
Cincinnati No. 4 Universal Miller, largest size.
Wire feed Screw Machines, various sizes.
Engine Lathes, 13 to 50 in. swing.
Planers, 16 to 60 in. wide.
Upright Drills, 20 to 36 in. swing.
Shapers, 12 to 24 in. stroke.
Bradley Hammers, 60 and 200 lbs.
Boiler Tools, Rolls, Punches and Shears.

J. J. McCABE,
14 DEY ST., NEW YORK.
Philadelphia Branch, The Bourse.

SECOND-HAND TOOLS,
Practically New.

Cleveland Automatic Screw Machines.
Garvin Bicycle Hub Machinery.
Garvin Bicycle Chain Machinery.
Ferracute Power Presses, dial and roll feed.
Full particulars and prices on application.
Retiring from business.
THE MOORE CYCLE FITTINGS CO.,
Harrison (Newark), N. J., U. S. A.

BARGAINS IN

NEW AND SECOND-HAND MACHINERY.

Lathes, from 12" to 48"; Planers, from 20" up to 60. 48", 54" and 60" Radial Drills; No. 2 Newton Milling Machine; No. 2 Screw Machine; Shapers, from 6" to 30", Boilermakers' Punches, Shears, Edge Planers, Rolls, Drills, Engines, Boilers, Pumps, and Dynamos.

FRANK TOOMEY, 131 N. THIRD ST., PHILA.

SECOND-HAND GAS ENGINES.

1 16½ H. P. Slide Valve Otto Gas Engine, complete, with fly-wheel and belt pulley..... $275
1 8 H. P. Otto Gas Engine, with iron base, complete, with fly-wheel and belt pulley. 200
1 8 H. P. Otto Gas Engine, without iron base, otherwise complete 175
1 7 H. P. Charter Gas Engine, with b se, fly-wheel and pulley..... 200
1 3½ H. P. Gas Engine, Upright, with fly-wheel and pulley..... 125
1 2½ H. P. Olds Gas Engine, Upright, two fly-wheels and pulley..... 185
1 2½ H. P. Otto Gas Engine, Upright, with fly-wheel and pulley..... 140

S. M. YORK, Cleveland, Ohio.

WANTED

1,000 lb. STEAM HAMMER,

in good condition.

MOSSBERG & GRANVILLE MFG. CO.,
PROVIDENCE, R

Turret Drills
with from 4 to 12 Spindles.
Milling Machines
with 4 Spindles
Manufactured by
A. D. QUINT,
3 CLINTON ST., HARTFORD, CONN.

SECOND-HAND MACHINERY.

ENGINE LATHES.

1 11 in. x 4 ft. [illegible]
1 14 in. x 3 ft. 6 in. Putnam.
1 14 in. x 3 ft. 6 in Prentice.
1 15 in. x 6 ft. Starr.
1 15 in. x 6 ft. W. & L.
1 16 in. x 7 ft. D. & H.
1 18 in. x 8 ft. D. & H.
1 27 in. x 10 ft. D. & H.
1 32 in. x 13 ft. Bement.
1 48 in. x 18 ft. G. & S.
1 48 in. x 16 ft. Fifield.

PLANERS.

2 16 in. x 16 in. x 4 ft. Hendey.
1 24 in. x 24 in. x 6 ft. Powell.
1 28 in. x 28 in. x 8 ft. G. & S.
1 30 in. x 30 in. x 8 ft. S. & S.
1 30 in. x 30 in. x 10 ft. Niles.
1 32 in. x 26 in. x 12 ft. Gray.
1 36 in. x 36 in. x 12 ft. Powell.
1 36 in. x 36 in. x 18 ft. Sellers.
1 54 in. x 54 in. x 20 ft. Niles.

SHAPERS.

1 9 in. traveling head, Wm. Sellers.
1 13 in. Traveling Head, Bement.
1 16 in. G. & E., triple G.
1 16 in. G. & E., single G.

DRILLS.

1 34 in. Harris, Bk. G.
1 32 in. L. & D.
1 3-spindle Hendey.
1 No. 3 4-spindle Garvin.
1 6-spindle Quint.
4 Suspensions, Pond.

SCREW & CHUCKING MACHINES.

1 No. 2 P. & W., plain.
1 No. 1 Costello, wire feed.
1 No. 2 Costello, wire feed.
1 No. 2 1-2 P. & W., wire fd
1 No. 4 Windsor, plain.
1 No. 4 Windsor, wire feed
1 No. 2 Niles.
1 18 in. P. & W. Chucking Machine

MISCELLANEOUS

1 P. & W. Grant Pattern [illegible] ller.
1 48 in. Niles C. W. Borer
1 48 in. Industrial C. W. Borer.
1 72 in. Niles B. & T. Mill.
1 3 ft. Riveter, "Portable."
1 No. 2 P. & A. Cyl. Borer,
1 10 in. New Haven Slotter.

Send for New List. Prices on Application.

THE NILES TOOL WORKS CO.,
138 Liberty Street, New York City.

FOR SALE.

Complete plant for manufacture of Eyelets. Capacity 15 million eyelets per week.

Also with above, Engine Lathes, Drill Presses, Power Presses, Foot Presses, Screw Presses, Drop Hammers, Iron Planer, Screw Machine, Small Tools, Dies, etc.

The above machinery is set up and in operation in room with power, light and heat, etc., which can be rented if desired.

Address P. O. Box 1435,
PROVIDENCE, R. I.

We have rented

an additional warehouse at No. 65 South Canal Street, and will place in same a large consignment of both new and second-hand Machine Tools, which will be offered at special prices.

Almost two hundred machines in stock.

Do not fail to write us before purchasing.

J. B. Doan & Co.,
68-70 South Canal Street, Chicago.

Almost New Machine Tools

—AT—

SECOND-HAND PRICES.

1 84 in. x 18 ft. Engine Lathe.
1 26 in. x 14 ft. Fitchburg Engine Lathe.
1 English Slotter, 14 in. stroke.
1 Universal Radial Drill, 5 ft. arm.
1 63-in. Pond Vertical Boring Mill.
1 6-ton Single-Acting Steam Hammer.
1 2-ton Double-Acting Steam Hammer.
1 2,500-lb. Double-Acting Steam Hammer.
1 Helve Hammer.
1 No. 7 Hilles & Jones Shear.
1 Morgan Electric Crane, 15 tons.
3 Dynamos.

HILL, CLARKE & CO.

136 Oliver Street, BOSTON, MASS. | **12 South Canal Street, CHICAGO, ILL.**

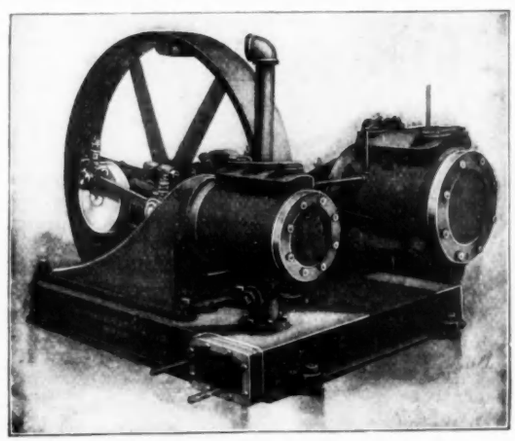
U. BAIRD MACHINERY CO.

523-525 Water St.; 524-526 First Ave.,
PITTSBURGH, PA.

MACHINE TOOLS.

SECOND-HAND TOOLS.

One 36 in. x 28 ft. Betts Engine Lathe.
One 24 in. x 10 ft. New Haven Engine Lathe.
One 21 in. x 7 ft. Lodge & Davis Turret Lathe.
One 15 in. x 5 ft. A. T. & M. Co. Fox Lathe.
One 30 in. x 30 x 7 ft. New Haven Planer
One 26 in. x 26 x 7 ft. New Haven Planer.
One 48 in. A. Box & Co. Radial Drill.
One 36 in. Gould & Eberhardt Spur Gear Cutter.
One 19 in. Putnam Slotter.
One 10 in. New Haven Slotter.
One 48 in. Pulley Borer.



Duplex Class "J" Compound.

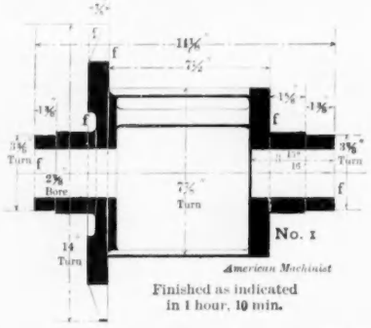
Air Compressor

This type of machine represents the most durable, compact and economical of small and medium size air compressors. Automatic in action, thorough system of intercooling.

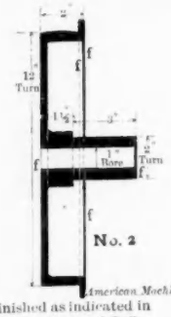
May be driven by belt, water or electric motor, gas or oil engines.

Rock Drills, Channelers, Coal Cutters, the Pohle Air Lift Pump.

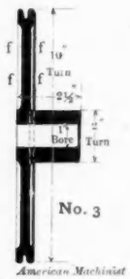
THE Ingersoll-Sergeant Drill Co.,
Havemeyer Building, New York.



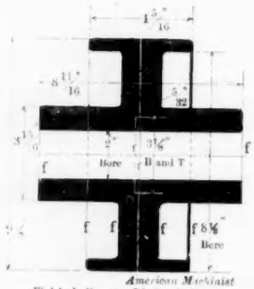
Finished as indicated in 1 hour, 10 min.



Finished as indicated in 42 min. Crowned Pulley

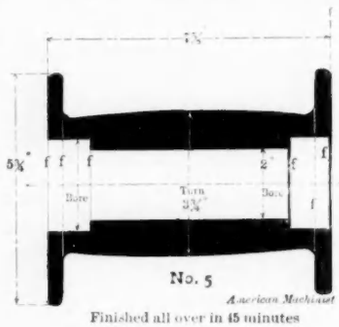


Finished all over in 30 min. Rope Pulley

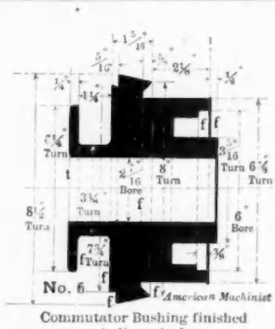


Finished all over. 2 halves in 1 hour

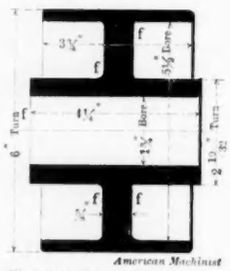
No. 4



Finished all over in 45 minutes

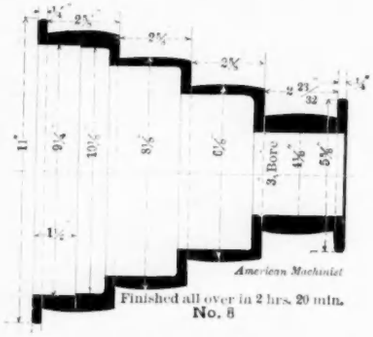


Commutator Bushing finished as indicated 1 hour



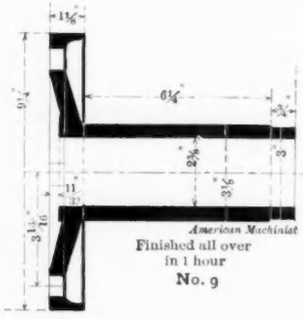
Finished all over in 35 minutes

No. 7



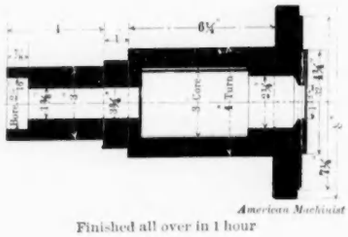
Finished all over in 2 hrs. 20 min.

No. 8



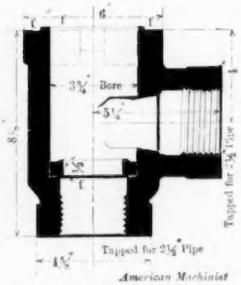
Finished all over in 1 hour

No. 9



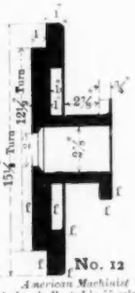
Finished all over in 1 hour

No. 10



Finished as indicated in 35 min.

No. 11



Finished as indicated in 55 min. This is an average of 8 pieces, and includes setting tools.

Samples of work finished on "Gisholt" Lathes in times noted.

Write for Catalogue.

Gisholt Machine Co., Madison, Wis., U. S. A.

AGENTS:

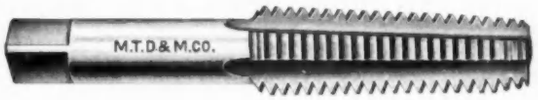
Eastern Branch, 126 Liberty St., New York; Walter H. Foster, Manager.
U. Baird Machinery Co., Pittsburg, Pa.
C. W. Burton, Griffiths & Co., 1, 2, 3 and 4 Ludgate Square, London, E. C., England.
Fenwick Freres, 21 Rue Martel, Paris, France.
Schuchardt & Schütte, Spandauer-Strasse, 59-61, Berlin, C., Germany.
Schuchardt & Schütte, Breitegasse, 17, Vienna. VII., Austria.

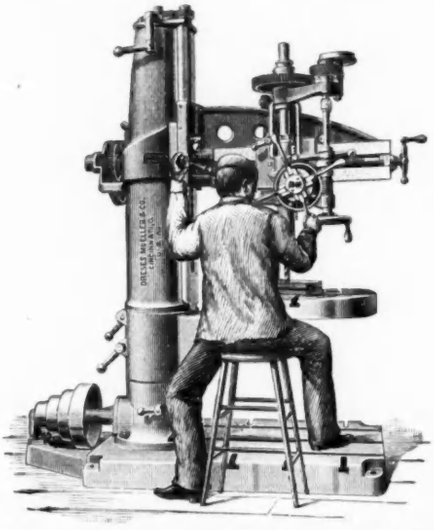
SETS OF MACHINISTS' HAND TAPS.

We make a large line of
Drills, Reamers, Chucks, Milling Cutters, Taps and Dies and Machinists' Tools.

What is not worth reading more than once is not worth reading at all. C. J. WEBER.

MORSE
TWIST DRILL AND MACHINE CO.,
New Bedford, Mass., U. S. A.
PATCH-BOLT TAPS.





EASY AND CONVENIENT

are our new

RADIALS.

All manipulations, as STARTING, STOPPING, ENGAGING and DISENGAGING BACK GEARS, reversing QUICKLY for TAPPING, CHANGING feed, etc., can be performed by the operator without leaving his seat. GREAT TIME, TOOL and MANUAL LABOR SAVERS.

DRESES, MUELLER & CO.,

Manning, Maxwell & Moore, New York, Pittsburg and Chicago.
Pacific Tool & Supply Co., San Francisco.
Selig Sonnenthal & Co., London.
E. Selig, Jr., Berlin.
V. Lowener, Copenhagen.
G. Koeppen & Co., Moscow.
Rietschoten & Houwens, Rotterdam.

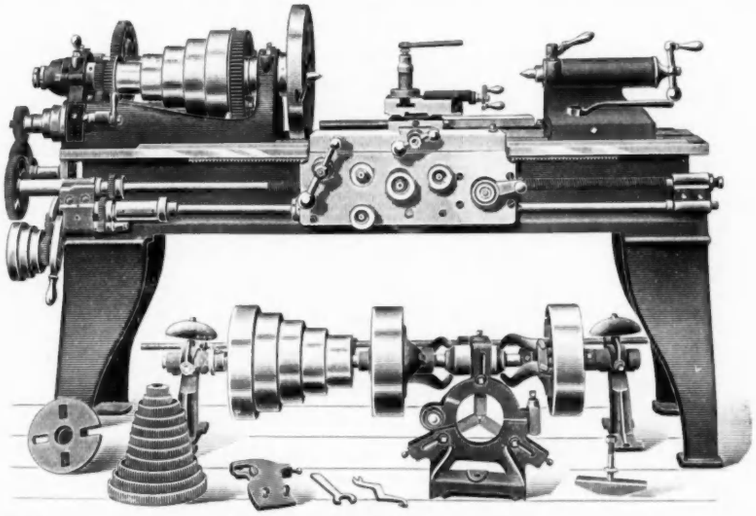
THE BECKER VERTICAL MILLING MACHINES

Built ONLY by John Becker Mfg. Co.
Fitchburg, Mass.

Drop us a line if you are unacquainted with them.

J. W. Cregar, The Bourse, Philadelphia, Pa. U. Baird Machinery Co., Pittsburg. Hill, Clarke & Co., Chicago.

Of course you want the best—that is the "Bradford."



14, 16, 18, 21, 25, 31 and 36 inch.

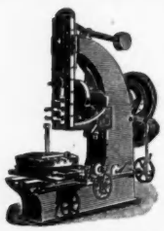
Beds any length desired.
English or metric screws.
Any form of tailstock.
Patented feed arrangement.

Feeds can be driven with either belt or gearing without disconnecting either. Lathes are furnished complete. Compound rest and improved taper attachment if desired. These Lathes are adapted to handling either light or heavy work and are all carefully tested before leaving our works. Write for Catalogue A to

The Bradford Mill Company, Cincinnati, Ohio, U. S. A.

Lieber's Code used. Cable address: "Stewart, Cincinnati."

Charles Churchill & Co., Ltd., London and Birmingham.
Schuchardt & Schutte, Berlin, Vienna, Brussels, Stockholm.
Pacific Tool and Supply Co., San Francisco, Cal.
Adolphe Janssens, Paris, France.
The E. A. Kinsey Co., Cincinnati, Ohio.
Philadelphia Bourse, Philadelphia, Pa.
J. A. Fay & Egan Co., Chicago, Ill.
J. W. Wright & Co., St. Louis, Mo.


14-INCH SLOTTER.

MACHINE TOOLS OF ALL TYPES AND SIZES

. . . Patterns for 300 Different Types.

Photographs and Descriptions on Application.

THE NILES TOOL WORKS CO.,

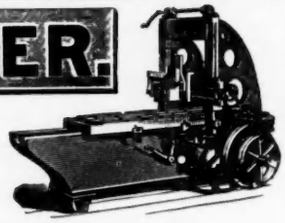
Hamilton, Ohio.

NEW YORK. CHICAGO. PITTSBURGH. PHILADELPHIA. BOSTON. ST. LOUIS.

GREAT BRITAIN: 39 Victoria St., London, S. W.

3-SPINDLE RAIL DRILL.

THE GRAY PLANER.

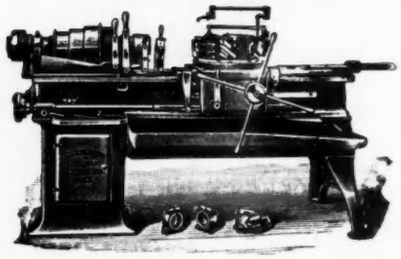


The G. A. Gray Co.,

Cincinnati, Ohio.

Manufacture Planers as an exclusive specialty.

—Planers only! Nothing but Planers!!



The Flat Turret Lathe

Does Lathe work accurately up to 2 in. diameter by 24 in. long.

Jones & Lamson Machine Co.

MAIN OFFICE AND WORKS:

Springfield, Vermont, U. S. A.

A B C and Lieber's Codes Used.

English Offices: Room 6, Exchange Building, Stephenson's Place, Birmingham, G. H Pond, Manager; and 26 Pall Mall, Manchester, in charge of Henry Kelley & Co.

Germany, Belgium, Holland, Switzerland and Austria-Hungary. M. Koyemann, Charlottenstrasse, 112, Dusseldorf, Germany.

William Sellers & Co. Incorp.

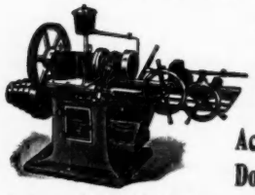
PHILADELPHIA, PA.

MODERN TOOLS FOR MODERN METHODS.

PULLEYS and SHAFTING. Boring Mills Bending Rolls, Bolt Cutters, Cranes, Lathes, Planers, Slotters, Punches and Shears, Mechanical Stokers, Turn-Tables, Testing Machines, Etc. INJECTORS for ALL SERVICE.

The Acme Machinery Co.,

CLEVELAND, O.,



Manufacturers of

Acme Bolt and Rivet Headers.

Acme Single, Double and Triple Automatic Bolt Cutters. Cutting from 1-8 in. to 6 in. Diameter.

Also Separate Heads and Dies.

"Constant Angle" Twist Drills.

Accurate, Durable, Efficient.

THE T. & B. TOOL COMPANY,

Catalogue free. —Danbury, Conn., U. S. A.

Friction

is the cause of more depleted bank accounts in the mechanical world than anything else. Hub Roller Bearings kill this friction, reducing it to just about nothing at all, and the cost is trifling compared with the savings affected.

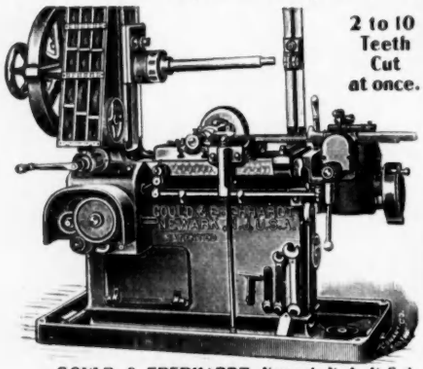
The Ball Bearing Co.,

12 Watson Street, Boston, Mass.

Patent Entirely Automatic

GEAR CUTTERS

and "Radial Duplex" Gang Cutters.



2 to 10 Teeth Cut at once.

GOULD & EBERHARDT, Newark, N. J., U. S. A.

Schuchardt & Schutte, general agents, Berlin, Vienna and Brussels; Selig, Sonnenthal & Co., London, England; John Lang & Sons, Johnstone, Scotland; White, Child & Beney, Shaper agents, Vienna, Austria; G. Koeppen & Co., Shaper agents, Moscow, Russia.

SHULTZ PATENT SABLE RAWHIDE BELTING.
BELTING CO.
SHULTZ
SHULTZ PATENT WOVEN LEATHER LINK BELTING
DYNAMO BELTING
GENUINE OAK LEATHER. SHULTZ'S PATENT PULLEY COVER. BELT DRESSING AND BELT CEMENT.
Send for Circular

EXPORT TRADE A SPECIALTY. ST. LOUIS, MO.

GRANT GEARS

GEAR WHEELS and Gear Cutting of every description.

GRANT GEAR WORKS,

630 Race Street, PHILADELPHIA.

6 Portland Street, BOSTON.

86 Seneca Street, CLEVELAND.

Send for Catalog.

WOOD WORKERS

BUCK CAST BROS. STEEL

Chisels, Gouges, Turning Tools, Carving Tools, Pattern Makers' Gouges. *Send for Price List.*

Buck Bros., Millbury, Mass.

MACH. MOLDED GEARS

Up to 16 ft. diameter.
Tooth Blocks Machine Cut.
Dry Sand Molds.

GLEASON TOOL CO.
6 Race St.
Rochester, N. Y.